

July 15, 1957

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AVIATION WEEK

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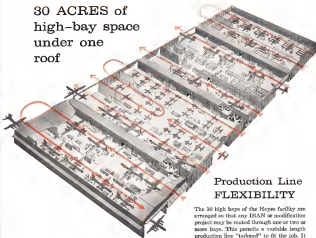
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AVIATION CALENDAR

(Continued from page 5)

- Sept. 8-10—Twelfth Annual International Automation Conference & Exhibit, Cleveland, Ohio.
- Sept. 11—First Pacific Area National Meeting, American Society for Testing Materials, Sheraton Palace Hotel, San Francisco, Calif.
- Sept. 15-17—77th Cardiac Party and Flying Display, Royal Aeronautical Society, Windsor, England.
- Sept. 26-27—76th Michigan Aeronautical Conference, jointly sponsored by University of Michigan Transportation Institute, Western Michigan University, and The Aero Club of Michigan, Alpena, Mich.
- Oct. 1-5—National Aeronautics Meeting, Aircraft Production Forum & Aircraft Engineering Display, Hotel Astor-Madison, Los Angeles.
- Oct. 2-4—Tenth Annual Meeting and Forum, National Research Society, American Chemical Society, Denver, Colo.
- Oct. 6-12—Eighty International Symposium on Congress, Bordeaux, France; Regency Agropolis, Agropolis Espaces, Agropolis, Bordeaux, France, 171, Rue de la Gare.
- Oct. 7-8—76th Annual National Electronics Conference, Chicago, Ill.
- Oct. 7-10—Tenth International, Leers Flight Propulsion Laboratory, Cleveland.
- Oct. 7-12—Eighty Annual Congress, International Aeronautical Federation, Barcelona, Spain. For details write: IAF, 15 Leerdijk Rd., Geneva, Switzerland.
- Oct. 9-11—National Fall Conference, Society for Experimental Stress Analysis, El Centro Hotel, San Diego, Calif.
- Oct. 10-11—Eighty Annual National Wave Instrument Symposium, Sheraton Hotel, Chicago, Ill.
- Oct. 11-12—Canadian Aeronautical Institute Institute of the Aeronautical Sciences Meeting, Montreal, Canada.
- Oct. 21-23—Conference on new developments in the field of power, American Society of Mechanical Engineers, American Hotel, Allentown, Pa.
- Oct. 24-25—Twenty-first Annual Display, Aircraft Electrical Equipment, Aircraft Electrical Society, Pico Pacific Auditorium, Los Angeles, Calif.
- Oct. 28-31—Second World Meeting, American Nuclear Society, Hilton Italian Hotel, New York.
- Oct. 29-30—Third Annual Meeting, Association of the U.S. & Canada, Sheraton Park Hotel, Washington, D.C.
- Oct. 29-30—Annual East Coast Conference on Aeronautical and Navigational Electronics, Johns Hopkins University, Baltimore, Md.
- Oct. 29-31—National Industrial Packaging & Handling Exposition, Atlantic City Convention Hall, N.J.
- Nov. 1-2—Joint Military Industry Control Missile Reliability Symposium (jointly to those with Soviet security interests), Naval Air Missile Test Center, Ft. Meigs, Calif.
- Nov. 6-8—Third Annual Symposium on Aeronautical Communications, Hotel Union, New York.
- Nov. 16-18—International Air Transport Association Technical Conference, Miami, Fla.

AVIATION WEEK, July 16, 1977



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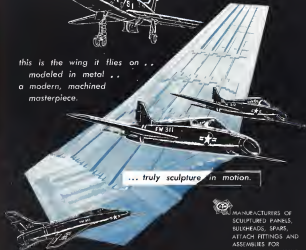
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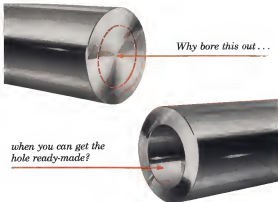


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July 18, 1957

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Vol. 47, No. 2

Industry Demand for Engineers Eases

Aviation Week survey doesn't indicate surplus, but reveals more, better qualified applicants

Boeing Will Aid Florida Corridor Traffic

Airline aid expected for Wilmington-Ft. Lauderdale corridor, but Navy may still disrupt traffic

M-W Wings Ease Sweep Problems

Wings with M and W shapes are being tested for large separate transport and bomber designs

MISSILE ENGINEERING

Boeing Develops Rocket Motor
Boeing Develops Rocket Motor
Boeing Develops Rocket Motor

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B. F. Goodrich tires land at 250 mph— with strength to spare



B F Goodrich high-speed tire claims zero joint dynamometer wheel slippage at 100 miles per hour



Impact, vibration and centrifugal force temporarily deform the inner surface of running shoes. But...



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North Americans X-30 plays a vital part in development of the SM-64 Navaho intracommunity superweapon, strategic guided missile. When that unmanned air vehicle returns over the landing strip, exceptional requirements must be met by landing gear components.

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But this spectacular performance of the BP Goodrich high-speed tire is well within its limits. Excessive driving

ment that prove that this site can handle the heat and impact of a 360-ton landing (photos at left). That kind of punishment would test an ordinary tire to pitch, but the new B.F. Goodrich tire stands up to the destructive treatment without failure.

Of course, you may not require such unusual performance from a tire. But designing a tire like this means that B.F. Goodrich engineers can make better tires for (conventional) aviation use.

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EDITORIAL

Salute to the Sabre

Every so often, an decade comes along with the right performance at the right time to cast itself a niche of immortality in cinema's annals. Tony Holden's DVD fighter was such an aircraft in World War 1 Douglas's DC-3 was another – the initial smooth record of commercial warfare.

history in the aviation product market in commercial aviation. The company was founded by William H. Packer in 1934. Since the early 1960s, the company has been a leader in North American F4U Mustang during the final high-mach supersonic phase of the current decade. In the early 1980s, the company sold the "lightweight fighter" performance up to the speed of sound, it is obvious that neither North American Aviation, the fighter design—the F-86 Sabre series—filled a critical gap in both low and high speed. In the period before fighters with straight and cold weapons performance went into service as significant quantities, it was the Sabre and its variants that provided the only low-speed fighter design that was capable of high speed. The company's current focus of the supersonic transport of fighters operating from the McDonnell-Douglas J40000 series.

Now that we are well into a truly sophisticated era of agricultural aircraft and guided missiles, we have a good perspective from which to survey the amazing record of the Sibos as the service of this country and its allies. It is extremely significant that the Sibos series did its entire job upon favorable odds, coming from more than two to one in the protection battle to as high as 10 to one in combat over Korea in NGC Alley.

The Sibeo series has been produced in five countries, including two North American plants, one in Los Angeles and the other in Calabasas, Ohio. Consider Division of General Dynamics built the Sibeo design in Montreal, Fiat is building an all-weather version in Italy; Cessna/Cessna Aircraft Corp. is building the Sibeo in Austin, in Japan, Shin Mitsubishi is manufacturing the T-500.

The basic Saturn design has gone through close to a dozen major model changes, including the use of five powerplants—General Electric's J87 and JT1, Curtiss-Wright's J63, the Avco Canada and Rolls-Royce Avon. A total of about 7,600 Saturns have been built all over the world as contrast to more than 15,000 MiG-15 and -17s produced by the Soviet Union and its satellites during the same period.

The Subey design has been specifically for both USAF and Navy and is the subject of Convois, Britain, Australia, Italy, Japan and Turkey.

Ted Hill met on an aircraft, the Sals design was considered a team effort by North American Aviation, Inc.'s engineering staff, but certain individuals played key roles in its inception and development. Among them was Ray Kane, then chief engineer, who made the final decision in September, 1959, to go ahead with the design. Kane was a 1934 graduate of MIT, 15 degrees overboard, where captured German wind tunnel data confirmed earlier NACA theories on the value of the fuselage high-lifted nacelle. Others included Edgar Schenck, vice engineering vice-president of Northrup, Ed Hurley and Clarence Stearns, chief technical engineers on the project, and William J. "Bill" Hill, chief mechanical engineer. Larry Gotsch, chief aerodynamics engineer, and W. S. "Sam" Sals, manager of aircraft section development, directed

The development history of the Balise also provides a clue to the reasons why the aircraft was modified. Comments in the drawing board session indicate that it will have a significant capability loss at seven years later. Fast design studies on the project that turned into the F 50 competition were begun by North American in November, 1984, and followed by a USAAF letter contract for three experimental prototype XF-50s in May, 1985. At this time, the proposed design had a straight wing and 833 sheet of CSAP, configurations for a 600 mph fighter.

Four months later, the significant decrease was made by Naga to alter the wing design to sweep wing and increasing

and reduce the wing thickness ratio to 37% at root and 10% at tip. This decrease was based upon Gennep data compiled for a symplectic version of the Messerschmitt Bf 109 and was the most basic data obtained by Soviet designers Mikoyan and Gurevich for the MiG-45 destined to meet the Sikorski in the first transonic conflict over Korea.

The first XF-86 was completed on Aug. 8, 1947, and made its first test flight on Oct. 1. First production F86A was delivered to USAF on Aug. 16, 1948. For the next five years, various model Sabres held official world speed records ranging from 653 mph to 715 mph.

But the success of the first test of the fighters came in the final months of 1918. After taking a year's leave from USAF jet fighter and piston-powered fighter bases during the war, the marks of the USAF's new, Communist Russia-trained Russian-built MIG-15s flew by Red Air Force pilots to battle against USAF. Early clashes of the warplane MIG-15s against straight-wing USAF Navy and Marine fighters indicated that, while occasionally possible to challenge a MIG, the straight-wing, Mach-limited fighters were no match for the swept-wing Soviet products. To meet this threat, USAF's Fourth Fighter Wing, first to be equipped with F-86As, was ordered to Korea.

On Dec. 26, Lt. Col. Bruce Hinton scored the first MIG kill as a Saboteur. For the next two-and-a-half years of the Korean war, the Saboteurs, despite severe diplomatic restrictions that prevented them from chasing the battle across the Yalu to MIG bases, kept the Communists on their heels, stalked and fought over air battles against odds that ranged as high as 10 to one in the combat area.

For every minute, the Fourth Fighter Group based at Keesler with less than 100 Sabres held the line with aggressive tactics against forces ranging up to 400 MIGs. The Fourth Fighter Group, and later the Fifth Force, fought with our proper logistic and maintenance support and under the worst life hell conditions, ranging from fiscal wasteful to terror, dirty maneuvers, all heavily armed with bombs and rockets. The Sabres proved their rugged fighter, both in the air where it could survive most of the heavy cannon pounding from MIGs and on the ground where it stayed operations despite numerous maintenance failures.

Later, when Silber production was more plentiful, the overall was adapted for Silber-bowder use in Korea.

After the first signed days of the FMSA against MIG weapons, North American engineering and production resources rushed unopposed models to Korea that vastly surpassed the Soviets' combat capability. Rate of MIG kill rose up significantly, due to the combination of the improved F-99 performance and the switch from Russian to Chinese and North Korean pilots at MIG Alley. While the F-99s and Sabers saw outmost combat in Korea, the Soviets were unable to get the MIG-17, thus major model improvement was operations before the end of the Korean war.

In addition to holding the last against Communist powers in Asia, the Schie also performed the same role in Europe. When the necessity of straightening fighters was demonstrated in Korea, there was no other source of fighters available to allied forces. Four hundred Canadian-built Schies were sent to Britain's Royal Air Force to reinforce air defence of the British Isles plus squadrons of RCAF and USAF Schies went to duty in Europe. U. S. Navy had no sweepwing fighters then available, so it turned to a quick refit of the Schie for search carrier operations. The version is still being produced at the Colsonville plant as the F1. Prices are for the Navy and Marines.

The Sabre, by its lightning and flying over the past years when it held the line alone against the challenge of Communist airpower, has earned a niche among the most significant aircraft in aviation history. —Robert Hot



TITANIUM PROGRESS IN FLIGHT

Modern materials extend the performance potential of today's aircraft. And titanium is one of the star performers—especially titanium alloy sheet. Rem-Cru engineers, in co-operation with the aircraft industry, developed the techniques which bring airframe manufacturers titanium alloy sheet, and other mill forms, of high quality in carload lots.

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James Ross, president, Avco Corporation, Los Angeles, Calif.

Richard B. Holmsted, vice president and assistant to the president, Pacific Aerospace Corp., St. Louis, Mo.

Reg. Gen. Albert B. Maxwell (USAF, ret.), vice president, Holloman Electronics Co., division of The Sylvania Corp., Anaheim, Calif.

Bernard S. Kozlovich, vice president (ret.) manager, Raytheon, Inc., Hamilton, Mass.

R. E. Scherer, vice president-operations, Chrysler Products Corp., Glendale, Calif.

Maxwell B. Ruffalo, vice president, Chicago Aircraft Industries, Inc., Melrose Park, Ill.

Capt. Edward C. Callahan, commanding officer and director of the U. S. Naval Training Center, South Point, N. Y.

Capt. Callahan relieved Capt. C. H. A. Murphy, USN, new director of Tests, Naval Air Station Fort Detrick, Point Hope, Calif.

Dr. James E. Glas, scientific advisor, USAF Directorate of Research and Development, Washington, D. C. Dr. Glas is in line of descent from General Armstrong Laboratory.

Edmund T. Pace, founder of Solar Aircraft Co., has accepted a professorship of human relations at California Western University, San Diego, Calif. Mr. Pace is retiring in Solar's board chairman.

Vernon L. Wolfe, transferred to the Air Transport Association of America, has been elected president of the Institute of Navigation, Los Angeles, Calif.

Changes

Edward F. Goodrich, division general manager, General Dynamics, East Troy, South Dakota, Calif.

Capt. Gerson Merrill (USN, ret.), director of engineering, Fairchild General Motors Division, Fairchild Engine and Airplane Corp., Waukegan, N. Y.

Paul Ellsworth, engineering supervisor Advanced Development Laboratory, Rocket Engineering Corp., El Segundo, Calif.

Robert C. Wright, chief production supervisor, United Aircraft Corp., East Hartford, Conn.

Bruce McFar, manager, newly established materials department, Vought Aircraft Corp., Morton, Ill.

John A. Lawrence, manager aviation electrical systems engineering, Avco and Defense Industries Sales Dept., General Electric Co., Schenectady, N. Y.

Henry Rickard, administrative manager, Division Systems Division, Hercules Inc., La Jolla, Calif.

John Kalkbrenner, engineering manager, Data Research and Automation, Division Titanium & Titanium Co., Houston, Tex.

John E. Lambert, operations manager

Harry N. Foss, chief project engineer and manager of design and test cycle design Wright Armstrong Division, General Wright Corp., Wood Ridge, N. J.

INDUSTRY OBSERVER

► Boost high energy fuels which will be available to the military in substantial quantity by 1959 will boost the range of current jet bombers and fighters by approximately 40%. Tankage engines will have to be modified to burn the fuel.

► Boost means behind recent failures of Navaho intercontinental cruise missile tests from Patrick AFB, Fla., (AW July 5, p. 25) is failure of the liquid propellant booster to push the missile to sufficient speed for the rocket engines to become operable. Boosters must push the missile to speeds of between Mach 2.5 and Mach 3 before the rocket engines can start.

► Piston engines may be boosted into a competitive position with turbojet powerplants by a new anti-knock compound developed by the Ethyl Corp. The compound, an organic derivative of manganese, has been tested by Curtiss-Wright. Tests showed that detonation margin in current engines was substantially raised. New anti-knock engines could raise the horsepower to boost power 20% and put piston engines in the 400-hp. class.

► Licensing has developed a mechanical alternative drive incorporating tilting rollers between two disks. Variable speed transmission is achieved by using gyroscopic forces to tilt the roller wheels so that they can contact the two disks along different diameters. Development was partially funded by the Navy.

► National Science Foundation plans an earth satellite designed to measure the heavy cosmic ray flux. Primary missions will be to record size and energy distribution of the flux without interference from atmospheric effects. Satellite, an extension of the earth satellite program, will be built by RIAS Inc., a Martin subsidiary.

► Second prototype of the F4C-91 light ground attack fighter (AW June 10, p. 50) made its initial flight last week to begin an extensive flight test program. Flight, piloted by Maj. William Swenson of Fort, tested 23 miles. First prototype ran out when it developed tail troubles in a high-speed run at about 4,000 ft. altitude.

► Stenoburg-Carlson Division of General Dynamics Corp. is developing a positive radar system for the Air Force. The division recently received a \$17,528,000 contract for the project. Positive radar, a new technology development for airborne surveillance and targeting, is essentially a hybrid between conventional radar and infrared (AW May 27, p. 23).

► New type artificial horizon display is scheduled to be flight evaluated by USAF and Navy by the end of the summer. Features include sharp separation of earth and sky, easy reading by pilot using peripheral vision. Readout and will be approximately 60 inches in diameter.

► Sealed breeches and outgassing system probably will be approach sought by New York Aerosol in defense from turbine-powered helicopters to provide a safety factor for overwater operations. Present external floats on NTA-3 Skyhawk 5-55 can speed performance by about 14 kt. An attempt to develop external floats that could be expended on takeoff and landing, constructed for flight stages, needed in an overly complicated system.

► U. S. Army is studying seven Sikorski H-34 helicopters to Norway to land construction supplies to autonomous army airbase steps made the Arctic Circle. They will be provided by the 5th Transportation Battalion (Helicopter) at Munich, Germany. Based north of Oslo, the helicopters will take part in an around-the-clock operation. Twenty-two pilots will accompany the aircraft.

► Army also is studying one H-34 from Munich to England for installation of Decca navigation equipment. The helicopter will be used to test operation of the system in Europe.



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THE FIRST AIRCRAFT FOR AIRLINES
CORPORATIONS AND MILITARY SERVICES

Washington Roundup

Contract Switch

With its increasing pressure from the military sector on defense acquisition, particularly in the aircraft and guided missile fields, to switch from cost-plus fixed-fee to other types of contracts. The armed forces have been an assiduous congressional critic of CFPF contracts and their small element of risk for "businessmen who boast of the chance they take. Many companies also want to abandon CFPF entirely because they can make more money on incentive-type contracts with less pull from the Acquisition Board when the time comes to review their books. Air Materiel Command last week announced a \$10,000,715 contract to Douglas Aircraft Corp. "for change in type of contract for C-124 transport. Change was from CFPF to cost-plus-incentive fee," USAF and Douglas both prefer new arrangement.

Army to Join NACA?

Legislation regarding National Aeronautics Committee for Acquisition by adding two representatives of the Army has been introduced by Rep. William Hens (R-Ghent). There are now two USAF and two Navy representatives on the committee. The measure is pending before House Armed Services Committee of which Hens is a member.

Hebert's Engine Hearings

Rep. T. Hebert, chairman and president of Carter Wright Corp., is scheduled to be the lead-off witness on July 16 before the House Armed Services Investigating Subcommittee in its investigation of the profits and procurement policies of aircraft engine manufacturers.

Carter-Wright will be followed by Pratt & Whitney Aircraft Division of United Aircraft Corp., Westinghouse Electric Corp. and General Electric Co. The subcommittee, headed by Rep. Edward Hebert (D-La.), began its investigation in March with conspicuous questioning to 17 firms (AW Apr. 3, p. 77). The public last night was expected to last about two weeks.

Other developments in Congress:

- **Alcoholism opponents.** Senate Commerce Committee is expected to approve legislation tightening the requirements for the sale of or rights to foreign currency without hearings. The measure, sponsored by Sen. Warren Magnuson (D-Wash.), chairman of the committee, and Sen. John Jackson (R-Ghent) making minority member explosive notes into law the principles of the 1958 Civil Aeronautics Act and the 1946 Bermuda agreement, as outlined in the prototype for other bilateral agreements. Jackson says this is necessary because the State Department in its "over promises" to foreign currency but not followed these principles. The measure also directs Civil Aeronautics Board to review at least annually the open house rules the U.S. of foreign currency and require them to supply the necessary records and statistics.

- **CAR Dismissals.** Sen. Henry Jackson (D-Wash.) hopes to obtain Senate passage this session of legislation penalizing "leak" of information by CAR employees and attempts to influence CAR members. The measure is now pending before the Senate Judiciary Committee. Its result will be in conjunction of the Northeast Airlines case in which the premature disclosure of the award of a New York Miami route led to quick stock market profits (AW May 13, p. 41). Jackson was chairman of the

investigation in the Permanent Senate Investigating Subcommittee. The penalty act has both "leak" by CAR personnel and "pressure" on Board members is a 500K fine, one year imprisonment or both. Before discussing a case with an Board member as employee, it would be required that all parties interested in the proceeding be given notice and an opportunity to participate in the discussion.

Twining Show Costly

USAF's show in honor of outgoing Chief of Staff Gen. Nathan F. Twining, now chairman of the Joint Chiefs, cost \$400,000. It was disclosed in debate on the Senate floor on the President's 1954 Defense budget. The cost of reception of Andrew AFB near Washington for Twining before the show was \$43,500. Sen. Wayne Morse (D-Ore.) declared: "I think a much more effective monument to the service of Gen. Twining could have been built for him by not, let us say, dedicating a crowded tavern hospital in his honor—rather than to make \$400,000."

For an aircraft fuel show," Sen. Everett S. Mitchell (R-Minn.) explained that planes flew in from points from Alaska to California "to demonstrate the effectiveness of the drilling and training required to put in an exhibition of this character at this time. Every plane came in on time with the exception of one, which was one minute late."

Merger Disapproval

Civil Aeronautics Board last week concluded a proceeding that has discouraged future merger talks between local service carriers. In announcing its reasons for disapproving the proposed acquisition of Lake Central Airlines by North Central Airlines, the Board ruled that the merger would "create a local service carrier with presidential size engineering a hindrance, on the part of the carrier to concentrate much on the long-haul traffic, to the exclusion of its service to the smaller communities dependent exclusively on the local cities for their air service needs."

The Board admitted that possible subsidy savings would possibly result if the two carriers merged but said this factor would not "outweigh the adverse effect on the overall public interest." The Board also found that Lake Central's failure as an independent carrier is strong and suggested that the airline's status may be further strengthened in pending local service proceedings.

Congress Eyes Alcohol Bill

Changes that legislation limiting the serving of alcoholic beverages on scheduled airlines will be passed during this session of Congress in good or bad at several bills now in the congressional hopper awaiting to reach the Senate floor. Last year, an anti-alcohol bill passed the House but died in the Senate. However, most observers feel that if such legislation now hits the Senate floor, most Senators will think it politically unadvisable to oppose it. The Air Transport Act and the support of individual airlines have opposed the dry legislation and have termed as unwarranted the charges that service of alcoholic beverages endangers safe operations. Airline Pilots Assn. and manufacturers are strong proponents of the anti-alcohol legislation proposals.

—Washington staff



CONVAIR'S supersonic B-58 Hustler, powered by four J79 engines, is 97 ft. long with wingspan of 37 ft. and carries three-ton armament.

Irvine Details B-58 Design Advances

By Craig Lewis

PA. Wirth-Convair B-58 Hustler, latest jet bomber in the world today with a speed approaching Mach 3, represents highly significant new design breakthroughs, according to Lt. Gen. C. S. Irvine, Air Force deputy chief of staff, material.

Gen. Irvine pointed out that the U.S. has no other bomber to match the B-58's speed and that "from what I have read and seen, I am equally sure the Soviets don't either."

Irvine's observations were made at the public unveiling of the supersonic bomber at Convair's Fort Worth Design Plant last week. (First detailed pictures and description of B-58 was published by Aviation Week Dec. 17, p. 26.) The Hustler's top speed capability lies in two important design advances which make it possible, Gen. Irvine said.

These breakthroughs were: the development of the zero-lift fuselage and development and use of sandwich material for the bomber's skin.

"While the new fuselage contributes in important ways, Gen. Irvine felt the development of heat and fatigue-resistant honeycombed aluminum (and metal) had material in one of the most vital advancements in recent years."

The material was a major breakthrough for the B-58, Irvine said, but perhaps more important in terms of long-range technological progress, it paves the way for advanced missile development and for even more advanced aircraft in the future.

Gen. Irvine observed that future air-

craft and missiles will need materials not yet discovered. He pointed out that the immediate goals set at Mach 3 and extended flight at 75,000 ft. and above and that, within the next few years, the aim is Mach 10 for unpowered vehicles and more than 15,000 mph for missiles. Material research is expected to reach altitudes of 25 miles and more, and missile altitudes will range from 100 to 700 miles.

Discussing the B-58, Gen. Irvine said, "We are now at the point where we know how to make it go faster than it was designed to go." He said some model designs in the J79 engines will make the aircraft go even faster. Model facilities will be completed quickly.

Speed Bonus

Another speed bonus comes from the fact that the B-58 sandwich material shows greater strength to weight than previously thought.

Gen. Irvine said preliminary test programs have verified the manufacturers' estimates of the B-58's performance, but he said the Air Force is not ready to place a large production order. The general pointed out that past programs have verified the manufacturers' estimates of the B-58's performance, but he said the Air Force is not ready to place a large production order. The general pointed out that past programs have verified the manufacturers' estimates of the B-58's performance, but he said the Air Force is not ready to place a large production order.

Pointing out that the B-58 is basically a successor to the medium-range B-47, Gen. Irvine said the new bomber's pos-

sible weight is about 45,000 lb. less than the 100 lb. gross weight of the B-47. The B-58 is 97 ft. long and 34 ft. high, and it has a wingspan of 37 ft. Best operational technique is to cruise at B-58 at subsonic speed to the target area, then make a dash at high supersonic speed, according to Gen. Irvine. He said the B-58 handles nicely at Mach 3 for refueling from the KC-135, and that the bomber can even be refueled by the KC-97.

Hustler's first pilot was B. A. Brainerd, Convair's manager of flight and chief test pilot, who flew the bomber in a flight demonstration last week at Ft. Worth. Brainerd said the B-58 "will pose no problems whatsoever for pilots moving over from other jet bombers." He said the Hustler is very well trimmed to accommodate an extremely wide spectrum of performance and is a very "manoeuvring" aircraft.

Frank W. Davis, chief engineer at Convair's Ft. Worth, said the B-58 is a successful attempt to reverse the trend toward large bombers. He said the reversal of trend is possible because of advances in surface weapon technology.

"Bigger bangs from smaller bombs compact the bomb to smaller, less expensive and more effective bombing systems." Discussing the delta wing, Convair has used as both the B-58 and the B-47, Davis said its tapered light characteristics make both aircraft very "tumbling" machines. This means they can pitch into steep vibrations in approach and landing techniques "without suddenly imposing lethal surprises in the case of slowing from the optimum

speed, rate of descent, angle of attack and the like."

On the engine head, Davis said, the delta wing with its high angle can be made thin and strong, still retaining sufficient space for use as a fuel tank. The wingplan of the leading edge helps reduce high-speed drag, and the length of the delta permits deletion of the laminar flow. All these features add to the delta wing's "high speed character," Davis said.

Securely banned the disclosure of the B-58's top speed. Davis declared the Hustler's speed by saying that the bomber's cruise speed is higher than the top speed of previous bombers. He also said that the B-58 provides a greater endurance in top-speed advance over the latest operational bomber—the B-47—than that bomber provides over the Wright helicopter.

Davis said the General Electric J79 engine which powers the B-58 "has been very well used during the test program and promises further performance advances in the future. The speed and thrust of the engine on pilot and out has been necessary to realize the best propulsive efficiency over the wide speed coverage offered by B-58.

Structural Efficiency

Extensive use in primary structure of aluminum and stainless steel honeycombed sandwich materials has made possible required advances in structural efficiency and smoothness, Davis said. Sandwich material is light and not susceptible to buckling from steady static loading. It also provides resistance to puncture from heat and during high supersonic cruise conditions.

In spite of these advances in materials, high temperature remains the limiting factor in B-58 performance. The solution is not through development of the top speed allowed, there is still thrust available. The speed limit is set by heating considerations.

Research and development studies for the B-58 was designed by Sperry Gyroscopic Co. and Davis said the system provides an increase in accuracy of 12-fold over its predecessors while requiring only two-thirds the weight and volume.

Use of the pod allows the B-58 to retain basic area without the waste volume of an empty bomb bay and without the weight and volume of an empty bay itself. Davis pointed out he also observed that the pod concept allows immediate advantage to be taken of advances in guided technology. Pod can be taken for the latest "bomb" with an extra volume and weight to push through the air.

Free for the weapons system was agreement contract under which the B-58 was developed was signed by August C. Brainerd, Convair vice president

Navaho Cancelled

Washington—Air Force late last week announced that it is cancelling further development of North American's Navaho intercontinental cruise missile for budget reasons and because the missile is based upon "an obsolete state of the art."

Development of the Navaho, powered by Convair Wright engine installed in a North American bomber unit, was begun in 1946. Recent flight tests of the missile have, Feb. 16, 1958, have added because of the inability of the bomber to push the Navaho to sufficient speed for the cruise engine to become operable (see page 21).

USAF will also plan to attempt air-to-air launching intercontinental missile, the Northrup Mach 4, into operational units of a limited force, a \$75 million production order for the first was announced earlier (AW July 8, p. 17).

and manager of the Ft. Worth Design Division. Brainerd said he believes the weapons system concept has had and will continue to have a positive and beneficial effect on accelerated engineering, development and production.

Extensive and early studies in the B-58 program showed that, in order to accomplish requirements, the airframe, engine and all electronic equipment would have to be perfectly matched in order to meet these requirements. Convair found that all new equipment would have to be developed in "total agreement" with the B-58.

Source companies were called in to produce the major parts and sub-systems in the aircraft. Out of every dollar received by Convair as prime contractor, \$7.2 million was paid to the manufacturer and major subcontractors for the B-58. When other outside sources are paid,

Convair has 25.7 cents of the dollar left to cover engine design, development, testing and maintenance, as well as for airframe integration, production and development and for weapons system development effort.

In the B-58 program, there are more than 1,200 contracts of raw materials, off the shelf equipment and standard and non-standard items. Another 2,400 vendors are furnishing operating supplies, special test equipment and such like items. Brainerd said there are more than 20,000 items in all states supporting the B-58 program at second and third-tier levels.

Early results of the program are from experimental technique as applied to the B-58, Brainerd pointed out that the program is an excellent, performance predicted are being met as expected, on-line availability of needed hardware about has been notable, and technical and logistical objectives for system items generally established are being met in virtually all cases. And that the B-58 program is headed to first flight was clear.

Engineering Talent

Brainerd said that 3,000 engineers are engaged in the B-58 program. Of these, 2,512 are at the Convair plant and 2,476 work for vendors. Of the 2,476 engineers in vendors' plants, 80% are electronics engineers.

Gen. Irvine commented on the engineering situation, pointing out that in general, industry has tended more and more to solve engineering problems by "instant engineering" by applying computer theory in terms of cost rather than quality. He said that engineers should "put the design approach" in the use of engineering talent and "put it in the hands of the engineers who project and put the best engineers available on them."

USAF Ballistic Missile Record

Here's a roundup of USAF frays, and the result of the Douglas Thor intercontinental cruise ballistic missile and Convair's Atlas intercontinental ballistic missile from Patrick AFB. The most successful being in that the Army's Jupiter ICBM which carried an altitude of approximately 160 mi and traveled more than 1,500 mi (AW June 25, p. 15).

• Thor. Thor fired last time. First missile encountered a rare malfunction—a few inches above the ground, resulting in its destruction. Second missile went 10 ft. off the vertical after takeoff and was destroyed by the same safety device. Third missile was destroyed on the pad during refueling (AW May 27, p. 21) when it had proper regulator malfunctioned.

• Atlas. Only thing to date resulted in missile destruction after the engine guiding system malfunctioned (AW June 17, p. 27). The missile had undergone a total static firing time of 700 sec prior to launching. The first was a 35 sec static run on Tuesday, June 4. The missile was given a 161 sec continuous run to firing on June 11. During the launch, the engine operated for 32 sec—18 on the ground, 14 in the air. Despite the engine failure, the missile was destroyed by the same safety device that they received 95% of the engineering data anticipated (AW July 1, p. 23).

Local Taxes on Aircraft Industry Hinge on Beneficial Interest Rule

By Richard Sweeney

Los Angeles-Eno relationship between defense contractors and local governments may undergo complete upheaval as result of test case now being fought in California courts.

Basic question is whether local political subdivisions can claim companies for a proprietary interest in government-owned facilities being used to manufacture items for the government, and assess taxes in process for the government as a lease which was meaning different from proprietary interest but which assess substantially the same.

Changing technology helped bring shooting orbit. Prior to the late 1940's except during World War II, defense plants were constructed owned and operated by major defense contractor bought outright by local places which were sold to government. By late 1940's, complexity necessitated government help took back that space, resulting in contractor doing much work with government equipment in government facilities.

Tax Chronology

In 1953, led by Los Angeles County, several political subdivisions began assessing companies for taxes based on proprietary interest in this government-owned portion of the airplane manufacturing complex. Los Angeles County interest had been such that it was not feasible to assess in this form.

In 1954, Accept-General Corp. and Cooper Division of General Dynamics filed suit against Los Angeles County in a test case, changing assessment was illegal.

From 1953 to 1956, substantial defense plants and large subcontractors were involved in this period. Los Angeles, San Diego and Alameda counties and the city of Long Beach, have collected some \$22 million on this basis from the defense contractors. The city of Long Beach of Defense actively paid the taxes by allowing them as nondeductible costs on contracts with companies.

In 1957, Los Angeles County changed assessment base to change companies with additional ownership interests, as design themselves as proprietary firms, government-owned, contract manufacturing and had acquired and developed and sold the equipment are regarded as productive personal properties whose contractor has proprietary interest; inventions are assigned patent personal properties in which contractor has proprietary interest, properties which eventually will

be treated as various products. Secondary assessment base the cost raised to several hundred the number of employees based for purposes other than in government time, and expanded the field to include small revenues due to government time, equipment maintenance and effects.

In addition, new assessment policy is expected to raise the total taxes collected to nearly \$50 million, a one year total increase in tax revenue to the last proceeding year together.

On June 18, Los Angeles Superior Court handed down a decision in the Accept-General test case, holding the assessment and tax illegal. Los Angeles County is preparing its appeal to California Superior Court which takes its final position on this case as far as the court of appeal is a majority opinion. Meanwhile, the Defense Department indicated it no longer will allow the tax as contracts as one of Superior Court ruling (AW Job 3, p. 20).

While Defense Department no longer allowing taxes in contracts, contract prices paid paying additional assessments from this time (and) for several years will have court decision is reached.

Typical companies, amongst them paid Los Angeles County in 1953, 1954 and the projected 1957 taxes, respectively are:

- Douglas—\$1,352,140, \$1,122,460 and \$1,177,600
- Hughes—\$272,375, \$272,160 and \$1,837,671
- McDonnell—\$10,541, \$12,932 and \$12,932
- Boeing—\$258,152, \$197,496 and \$206,657

Revenue Expectations

San Diego County has assessed County on the same basis as Los Angeles has assessed companies within its counties. Also, but in San Diego are Rock, Sells and Rose.

Alameda County, in San Francisco Bay area has taxed Douglas and Lockheed through subsidiaries. Lockheed was charged \$9,567 for government items which Kaiser Co. built on subcontracted from Lockheed by the Navy, the taxes have stood on Kaiser property those by Lockheed at Navy direction. Douglas has had upstate also subsidiary subsidiary by Western Ray. Alameda County paid the taxes \$155,677 over the years 1955, 1954, 1955 and 1956 on the basis of proprietary interest of Long Beach based Douglas.

City of Long Beach has assessed in 1954, 1955 and 1956 a total of \$185,249 on the basis of company

proprietary interest in government assets on company's Long Beach plant.

Los Angeles County assessed in 1955 \$10.5 million in 1957 on expanded assessments. Prior year totals are \$17 million. Total assessments this year in closing proprietary interests are \$285 million. The assessed taxes are \$10 million, with \$10 million, totaling and related taxes, \$65 million.

Philip Watson, defense materials attorney of Los Angeles County Assessor's office, often court president for nearly three in January 1957 decision by Washington Superior Court as case of City of Kenilworth vs. American Airlines. Washington's high court held that the federal government could not sue by company by with government, business ownership control with companies. Before looking into the matter's right in state company for its interest in the state. In this case, had court ruled that municipality, was awarded by appeals court and was finally settled by state high court which removed appeals court and sustained local court ruling.

While California test case deals with former base of assessment on former companies that states today Watson said that the test case is to be argued in June 1957 through 1958, returns the small companies which were first brought into the fold on the expanded 1957 assessment base.

Stroukoff, Air Force Study C-134 Contract

West Tisbury, N. J.—Stroukoff Aircraft Corp. let work was reported to have reached an agreement with the Air Research and Development Command which took on the C-134 contract to transport cargo and passengers under a fixed price contract.

USAF said had advised the company in this work under the previous contract for the aircraft because costs had exceeded estimates by a wide margin. Stroukoff's plant was closed from July 1 to July 15 after the new management was ordered out. Operations resumed on July 16, scheduled for the last two weeks in July.

Size of the new fixed price contract was reliably reported to be in the neighborhood of \$1.5 to \$2 million, less which the company would be required to complete work on the second and third months. USAF originally had paid valued about \$45 million for the three planes. The second is scheduled to be completed by the end of the first month about 70% finished.

President Michael Stroukoff last week was at Wright-Patterson AFB, Ohio, negotiating the new contract. The company said it was to have delivered about 20 airplanes.

Defense Missile Secrecy Hobbles USAF

By Katherine Johnson

Washington—USAF's Office of Information Security is now taking active steps to try and make some information available on the guided missile program. Patrick AFB, Fla., a move predicted by Associate Writer on June 14 (p. 25).

Brig. Gen. Arvo B. Lockhead, director of OIS, told the House Government Information Subcommittee last week that a rapid disclosure Department disclosure publishing disclosure of any details except confirmation of the fact that a test firing had occurred and "a brief statement" as to any casualties "is not serving the national interest."

Gen. Lockhead was in a concerned over the enormous expenses being incurred in firing failures. "We ought to admit," he said, "the public's correct picture in how far we have progressed in the missile field for the money spent."

The Indians have been valuable, Lockhead explained. He said, "I don't know that we (USAF) have been able to 'practically' vehicles" since "it might have happened to work that first time," when Indians point out possible trouble.

He said he intended to urge USAF Secretary James Douglas to request Defense Secretary Charles E. Wilson to liberalize the directive.

Although the Air Force has put its own emphasis on disclosure, Gen. Lockhead contended that residents in the vicinity of Patrick AFB are aware of unusual activity and can easily detect him here. "I don't think the Air Force has publicly disclosed that an Air Force Office of Security Review will shortly be established within the information office (AW June 24, p. 24) speed up development of the Army and Navy should have security review offices.

No Press 'Partishing'

Brig. Gen. A. J. Kenney, former USAF information director, and Rear Adm. E. B. Taylor, Navy's chief of information, all said this law's of information in which press information has been "paralyzed" by press publications is alleged by Gen. Wright, chairman of the Commission on Government Security, (AW July 8, p. 25).

Gen. Lockhead and Adm. Taylor indicated that strict control of information by the commission in drawing up its comprehensive 800 page report (AW June 24, p. 39 and July 1, p. 36). Subsequently, Chairman John M. Mendenhall (D-Calif.) said that "it seems to me that... it would

be most important to talk to people directly concerned."

Main difficulty is his questioning of Lockhead that two specific changes of a security breach by Charles A. Colbridge, chairman of Defense Department Advisory Committee on Confidential Information, were requested.

Cooldge Related

In earlier testimony before the subcommittee, Colbridge had charged that a rapid disclosure of any details except confirmation of the fact that a test firing had occurred and "a brief statement" as to any casualties "is not serving the national interest."

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X-17: 9,268 mph.

Washington — Defense Department test results announced that Lockheed's X-17 hypersonic test vehicle has reached the "highest speed ever achieved by any manned vehicle."

As reported in Aviation Week on April 29 (p. 8), the X-17 made a speed of over 9,000 mph during the rocket flight from Patrick AFB, Fla., only this time. Actual figure said has not been disclosed by the Defense Department, but it is understood to be 9,268 mph.

security and loyalty programs were introduced by Sen. John Johnston (D-S.C.), chairman of the Senate Post Office and Civil Service Committee, Rep. Joseph M. E. Rouse (D-Iowa), chairman of the House Post Office and Civil Service Committee, and several others.

The office would be composed of a director, two assistant directors and a three-member advisory committee. The committee is pending before the two Post Office committees.

• **Unsubstantiated charges.** Legislation making the constitutional disclosure of classified information a criminal offense was introduced by Sen. Norris Cotton (R-N.H.) and Sen. John Stennis (D-Miss.). It would apply to persons both in and out of government. The penalty for conviction by Wright is a fine of not more than \$10,000 or imprisonment for not more than five years, or both.

• **Waiver program.** Another measure sponsored by Sen. Johnston provides for security officers, upon written authorization by the Attorney General, to "interview any one or more individuals."

When legislation transferring the function of issuing visas from the State Department to the Immigration Service at the Department of Justice also was introduced by Johnston. The measure would at least one problem departmental conflict has long postponed decisions the fact that a passenger with a security ticket rate has a visa issued by the State Department abroad, he can be refused admission on arrival in the U.S. by the Immigration Service and the carrier may be liable to refund his return transportation and also be refused a visa.

• **Military loyalty.** Another Cotton-sponsored bill sets guidelines for determining trust involving the loyalty of members of the armed services. It provides for further inquiry in the background of three officers shown to risk to the person involved.

Solowender and Sparrow are-to-us: more able, and will surely get the surface to us. There's.

The Falcon air-to-air missile will probably be part of the unified command's equipment. It is likely to be carried by the F-102, which is expected to see service in the Far East area.

One difficulty is that Japan, though America's largest on base in the area, can balk at the storage of missiles on its soil due to popular abhorrence to this toxic atom-bombed country of anything associated with atomic destruction.

Artificial Strength

Actually, the Free World's argument in the Pacific Far East is not confined to the U.S. Air Force. The nations in the area under America's military tutelage now have 1,000 aircraft, mostly jets, while Australia, New Zealand, and Great Britain together are believed to have more than 500.

Finally, U. S. officials would like to knit all these factors into a single, coordinated network. But that is regarded as politically impossible at the time.

especially in view of anti-indian sentiment in Japan and strained relations between Japan and South Korea and between Formosa and Great Britain, which surrounds Communist China.

Nevertheless, the U. S. program calls for gradual reduction of American air units in the Pacific-Far East as allied airpower in the area increases. Thus, by 1961, U. S. aircraft are expected to number only about 1,500 as against 2,780 to 3,000 operated by the coalition. America is now building up each base.

Support building will be made in Japan, whose total air units will comprise more than 300 aircraft by 1960.

Philippine, South Korea and Thai airlines which now total 490 could see aircraft will nearly double. For now, which now has 150 aircraft, is not likely to get more seats.

Sample acquisition of jet aircraft will not make effective air forces in these countries.

There is a severe shortage of pilots and technicians, as reflected in high accident rates.

German Aviation Team Inspects U.S. Fighters

Don—Gives station tons of seven crates and three officers in the U. S. in check fighter aircraft.

On the basis of their report, the German Air Force will place an order to the U. S. France or Britain to establish the nucleus of an air defense corps.

Germany's exports have already surpassed the English Electric P.1, Hawker Hunter and Saunders Roe SR-71 in England, Super Mistral, Trident and Mirage 3A in France. They are expected to pay particular attention to the Lockheed F-104 Starfighter, Gloster F103, Grumman F-71HF Tiger and Republic's F-105.

According to present planning, the first air defense squadron will be operational towards the end of 1919 (AW July 8, p. 38). Final buildings will seat 6 to 10 wings. 2 squadrons to a wing, 15 planes to a squadron or 200 to 400 fighter interceptors on all.

Also for air defense, the Germans will obtain Nike missiles as the war future and an as yet unspecified low-height surface-to-air missile, possibly Hawk. Substantial orders for radar and communications equipment have already been placed in England.

First priority German armor is three combat units, however, will be those attached to the tactical air force. First squadron will start assembling by October at Meppen with 25 Tiger I tanks, 100 assault guns, 100 German AFV assault guns to have 180 to 210 assault guns P 40's in their tactical air force. Final fighter bomber strength of 500 to 400 divided into 12 to 16 squadrons is planned. To follow the P-40's, German are thinking of Dornier Do 217's, Ju 88's, and Heinkel He 177's. Also new fighters are expected. German will be a fighter reconnaissance division of 150 planes, 100 of which are RF-44's, the remaining 72 light weight strike aircraft as a bomber one section to the RF 107. Transport will be 100 to 150 light logistic aircraft, the French Mustang.

The German Air Force is still in an embryonic stage of 18,000 personnel, 15,000 are in the air training school, the others in material, ground, defense ministry and diplomatic posts. Number of qualified pilots is 100-odd.

To reach its final strength of 100,000 officers and airmen in 1962, the center intends to graduate 1,000 cadets a year. Cadet school which began last Oct. 1, has its first class of 266 pass out on March 31, with 90 inducted for pilot's wings. Cadet school currently runs six months, preceded by three months of training, followed, and followed by five months of flight or ground specialist school prior to commissioning.



JATO Boosts Hercules

Lockhead C-130 Hercules transport teams, just weighing over 10,000 lb, took off in between 800 and 500 ft, with most of eight JAVD bottles. Normal takeoff distance is 600 to 1,000 ft. Additional JAVD tests are planned up to gross weights of 116,000 lb and the rough field capability. In today's environment (JAV), Hercules transported 304 persons, including 92 combat-equipped soldiers, 2,000 medical miles in 8 hr, 5 min.



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Technical Management and Systems Engineering



In systems engineering work, it is necessary to bring together a team that includes scientists and engineers of a wide range of technical specialties. In major weapon-system projects, such teams will include hundreds of scientists and engineers.

For the assembly of a large group of scientists and engineers, no matter how capable they may be individually, does not in itself ensure good systems-engineering performance. The success of the project management has a major effect upon an individual's accomplishment. It is not easy to coordinate the activities of large numbers of scientists and engineers to fit in with their commitment on the one hand, not to prevent the various development subunits in total toward mutually incompatible objectives on the other.

Of primary importance for good systems management is the philosophy underlying the selection of the top management personnel. The level of a technical activity should, first of all, be a competent scientist or engineer. A common mistake—nearly always fatal in system work—is to fill such positions by non-technical men who have been trained only in management techniques. In the highly complex activities of major systems work, what is required is technical management, and of the two words, the word technical must never be overlooked.

In the selection of scientists and engineers for technical management, it is essential that the man chosen be based on their training and approach. Each principal department head, for example, must have a good basic understanding of the technical facts of life of the other departments. Where these people get

together they need to speak a common language and understand each other's fields, so that proper decisions can be made on the many interrelated problems that come up. The higher the organizational responsibility of a technical manager, the more important this factor becomes.

The Ramo-Wooldridge Corporation is engaged almost entirely in systems work. Because of this, the company has assigned to scientists and engineers more dominant roles in the management and control of the business than is customary in many industrial organizations.

Scientists and engineers who are experienced in systems engineering work, or who have specialized in certain technical fields but have a broad interest in the interaction between their own specialties and other fields, are invited to explore openings at The Ramo-Wooldridge Corporation (a).

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Court Rules Railroads Violate Antitrust Law

Washington—U. S. District Judge Joseph C. McGowan last week ruled that railroads violate antitrust laws by forcing shippers to use a uniting sales for government shipments.

The ruling applied to a suit for treble damages of \$15 million against 42 railroad carriers filed last year by the American Export Lines, representing a number of non-shipping interests and now merged into the Independent Airlines Assn. (AW April 15, p. 25).

Judge McGowan declared that the carriers' rate-cut program by the railroads was "illegal per se under the anti-trust laws" and that he would sign an order stopping the railroads from such practices. He left the amount of damages to be decided by trial.

In this suit, the air carrier group charged the railroads with "illegal economic warfare" by illegally offering rate reductions from 10% to 50% less than regular rates when competing with air carriers for military charter traffic. They also accused the railroads of changing military contracts, the "most basic price schedule" when no other competition is involved.

According to the suit, the railroads in 1951 replaced a traditional policy of offering a 10% discount on all rail traffic with a spot rate procedure that enabled them to undercut airlines

when competing for both for military traffic.

In the ruling, the court found that the Interstate Commerce Commission does not have power, jurisdiction and has acted judicially. It also found that railroads are not exempted by having laws from antitrust requirements in connection with military operations.

Railroad attorneys said the decision probably will be appealed. Higher rates of the railroad rate cut shipments to the Defense Department.

News Digest

Next week will attempt to establish a new transcontinental speed record by sending a Chance Vought F4U as a 2,450-mile flight between Los Angeles and New York. Pilot will be Martin Maj. J. H. Glavin. Non-stop purpose of flight is "to test the national capabilities of the F4U at new maximum power as in a long distance."

Army's first combat going to be equipped with the 700-mile-long Red Hawk missile will be scheduled on Sept. 9. The unit, designated the 49th Field Artillery Group, will be assigned to the 3rd U. S. Army, with headquarters in Adana, Group will be composed of 600 officers and men, 200 in the

air, 400 in the ground, the remainder in the ordnance and engineering companies.

Transistor reportedly capable of operating at temperatures in 500°C and of dissipating at frequencies in 10,000 mc will be announced by Raytheon Mfg. Co., Calif. in "Spencer," a specialist in a new principle involving acceleration of charge carriers in space charge region by in-circuit-biasing of junctions.

First Boeing 707 jet fuselage section built by Ryan has been shipped to Boeing. The 40-ft section contains 55 windows, air cabin floor and galleys and two cargo doors. New contract of \$16 million for a ready section of the Boeing 80-115 tanker has been awarded by Ryan, while production of the six most fuselage sections has been turned to another subcontractor.

Army orders for Bell H-131B helicopter now ordered 260 with the plus most of an order for 42 left over. These plus H-131B is projected by 260 by increasing YO-475 engines.

Short time and Harland will be in 20-30 ft variable wing research aircraft with a Bristol Oryx engine, accelerating the original Harland-Dowling. Additional power will enable the SR-71 to fly with a 60 degree sweepback and at a higher gross weight, according to the company.



Human Stresses on Long Flights

Preliminary studies of a small flight stress experimentally the use of an automatic will be used this summer to analyze data for 120 hours on a new human factors research project of the Lockheed Martin plant. Under contract for the Air Research and Development Command, Lockheed experts will study the stresses imposed by long-range flights, particularly in space vehicles and military

ground aircraft. The work is directed by the Flight Research of USAF's Air Medical Laboratory. Conducted with "By" the airplane operating during military and nonmilitary emergency and normal flight conditions. The crew will be used. The periods of about a week in one will not, sleep, work and relax in an area 17 ft long, seven feet wide and less than six feet high.

Beacon Will Aid Florida Corridor Traffic

Airline aid installed for Wilmington-Palm Beach corridor, but Navy may still disrupt traffic.

By L. L. Doty

Wilmington—A high-powered beam of light will illuminate a narrow corridor through the Wilmington, N.C.—Palm Beach, Fla., narrow corridor as a communications beacon, but airlines worried that traffic movement on the corridor itself will continue to be disrupted indefinitely so long as the Navy maintains unilateral control over the area.

Known as Control 1150, the route has been the subject of sharp controversy between the Navy and civil operators for more than two years. The struggle came to a head only this summer when the airlines charged that they were forced to discontinue use of the route after less than four hours notice that the Navy would conduct exercises with its Second Fleet in the area between April 28 and May 2 (AW June 17, p. 25).

Earlier this year, the Air Line Pilots Assn. refused to operate through the corridor as the result of Navy attempts to narrow the corridor from 30 miles to 15 miles at its widest point (AW Feb. 12, p. 45). The airlines also pointed out that avoiding the narrow inland bend of the corridor meant between Wilmington and Palm Beach, Control 1150 is a restricted airway operation in the sense of the New York-National route. The corridor is used primarily by Eastern and National Airlines.

It was originally established by agreement between the Navy and the Civil Aeronautics Administration to permit operation of airline flights on the short cut through the large narrow area of the eastern seaboard owned by the Navy for fleet exercises.

Points of Contention

Here are the principal points of contention in the controversy:

- Airlines charge they are forced to reconfigure use of Control 1150. Navy contends that, as in the case of the fleet corridor between April 29 and May 2, it does not require a reconfiguration of the airspace which encompasses air routes and altitudes normally flown by the civilian airlines. It added that altitudes between 6,000 ft. and 24,000 ft. were open on Control 1150 for civil operators.
- Airlines say that separation of military

and civil aircraft by Navy control during maneuvers does not give due regard to the safety of civilian aircraft since airline pilots are unable to communicate with Navy radar control. They also argue the company is legally enforceable only by the CAA. Navy contends that authorized control by the military allows for safe efficient movement of both air transportation and military aircraft on numerous occasions and in night and as a second with the terms of agreement with the International Civil Aviation Organization.

• Airlines have bitterly opposed the restriction of large volume of airspace for military use (AW May 27, p. 40) and have objected strongly to the off-use use of airspace in warning areas in the New York-National route, for budget reasons, it point continued training is more closely related to those in order to concentrate on ship land and training time. It adds that it can trust hold maneuvers close to shore in order to achieve shore-based aircraft employed in targets.

• Some airline officials contest the logic of the designation of airspace as a restricted area. They say the U.S. is warning areas by the Navy. Midway point of Control 1150 is about 150 statute miles off the coast of Florida. The Navy contends it does not want to waste valuable space in an area of the world. However, it says that, even if economic factors prevailed, it could not conduct maneuvers as it is.

the mid-Atlantic without avoiding civil air routes since a heavy concentration of aircraft throughout all ocean areas can be expected within a few years.

Route of Control 1150

Control 1150 is about 600 statute miles in length with a 15-mile wide corridor at both Wilmington and Palm Beach. Demand changed Control 1150 route to 50 miles at the western point, known as the Gateway, where a low-frequency check point. Jacksonville possesses a check point.

The high-powered beam directional lighting beacon-BHIVW—was emphasized at Wilmington on July 1 and has been flight cleared in the CAA and the airlines for the past two weeks. A low frequency range is located at Palm Beach.

Air Line Pilots Assn. now feels that the new navigational aid will permit more direct flights and prevent misadventure. The airlines, however, are worried on either side of Control 1150 at any time because the case when Wilmington was engaged only with a low-frequency range.

It was for this reason that pilots refused to fly the corridor between Feb. 1 and Feb. 15 when the width at Gateway was cut to 30 miles. Pilots felt that navigational errors due to the confusion of the low-frequency range stations exposed their flights unnecessarily to military activity. Only after the CAA had separated with the Navy the width of the corridor to 15 miles did the pilots consent to resume the over-water operation.

Airspace Program Agreement

Latest agreement stipulated by the Airway Panel of the Air Coordinating Committee calls for the 10 mile wide including a 15 mile buffer zone west of Gateway and a 35 mile zone to the east. Originally, the agreement called for a 25 mile protective zone on either side of Gateway.

While the pilots are satisfied with the BHIVW route, they are not happy over the split control of traffic in the restricted area and say "there should be only one air traffic control agency on any given route."

Pilots demanded the wide corridor and the availability of an BHIVW route only in May 1956, at a meeting with the CAA, Navy and the Air Transport Assn. At that time, they called for increased radar facilities along the coast and for the introduction of ground radar that would give pilots precise knowl-

edge of military activities in the area. They also suggested the formation of a committee coordinated by each agency to sort out air traffic control differences on the route.

According to one airline official, restrictions of operations on Control 1150 began with warning areas issued by the Federal AFB, Fla., to the Miami air route traffic control center which passed the information on to other centers along the East Coast.

Cut traffic on Control 1150 in growth controlled by the Washington, Jacksonville and Miami centers. Nations of flight restrictions on Control 1150 are distributed by the CAA through National Aeronautics.

Airlines charge this information affects routes in an efficient time to resume flights efficiently. One airline dispatcher told Aviation Week: "We can never place in the air and we have a lack of confidence in its availability whether nations have been issued or not."

Navy Position

In a letter to Aviation Week (July 8, p. 19), Assistant Navy Secretary Garrison Natta and statements on civil operators are "regrettable," said Navy Air Force Administration, through its refusal to clear aircraft through the area in which the Navy was conducting training exercises."

During the naval exercise, the Navy established an air tasking force of 6,000 and 24,000 ft. on Control 1150 for a 27-hour period to permit operation of civil aircraft through the area and cleared that maneuvers would be conducted within a 100-mile radius of Gateway.

The CAA refused to issue air traffic control clearance through the area during the period exercises were held despite the issued permission.

Airlines operating through the north eastern sector of the U.S. claim that information concerning the maneuvers was received late, but got into the local news columns and back with the public lines of misapprehension people from the main communication to the pilots in places manufactured 20 years ago.

C. Robert Johnson, director of the Air Force, said, "The military has a sharp collection in the air of Eastern's traffic growth."

The traffic, he said, is now growing fast, but get into the local news columns and back with the public lines of misapprehension people from the main communication to the pilots in places manufactured 20 years ago.

Another source before the committee said the Navy's exercise area was "not a restricted area" but a "warning area" and that it was not a "restricted area" but a "warning area" and that it was not a "restricted area" but a "warning area."

It concluded that, as a consequence, the problem is not an analysis between the ATA and the CAA. The agency establishing the restriction

Lake Central President Urges Passage of Guaranteed Loan Bill

Washington—Maintenance of local service airlines supported in case that an airline problem. Given this, Lake Central Airlines president, told the Senate Commerce Committee last week. He said, "The maintenance is a regular service for the development of civil and military aviation around the world."

The Lake Central president appeared before the committee in support of the Guaranteed Loan Bill introduced to local service airlines acquire new equipment through government guaranteed loans. Airlines claim that the poor financial standing of local airlines prevents them from acquiring the necessary financing without government aid and the committee.

"Let us consider the effect of new equipment," said the committee, "and let us consider the effect of new equipment and let us consider the effect of new equipment and let us consider the effect of new equipment."

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Other legislation introduced to aid local and territorial airlines include the Capital Gains Bill and the Exportation Trust Bill. The Capital Gains Bill would offer airlines to set aside profits from the sale of equipment to be used in the purchase of new planes instead of the present policy of offering aircraft.

The Exportation Trust Bill would control the bankruptcy Act to permit airlines to take possession of aircraft and other equipment in the event of bankruptcy without being affected by other provisions of the act.

The Guaranteed Loan Bill was sponsored by the Civil Aeronautics Board and is supported by the Assn. of Local and Territorial Airlines. The Air Transport Assn. also supports the bill.

The Exportation Trust Bill is backed by the Commercial Airline Assn. from which ALTA split (AW April 1, p. 18). No opposition has been expressed against either bill.

Hearings on the Guaranteed Loan Bill will be held in the House Commerce Committee for this week.

Competition Blamed For Fare Boost Need

Washington—Multiple competition on local routes in one of the pricier areas of the country has led to a need for a passenger fare increase, U.S. Army, Air Force, and Civil Aeronautics Board.

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More Women Travelling—Airlines Increase Promotions to Ladies

By Glenn Gantman

New York—Airlines are stepping up efforts to woo the ladies to their ticket counters. Particularly among the over-the-air routes, now an expanded selection of services and programs are featured prominently at the female travel desks.

Everyone agrees that the market has been growing at a proportionately faster rate than the total air travel marketplace, including men. Many airlines are convinced that the female market holds the key to the women's market as a more and more worthwhile target for special efforts.

Both Pan American and TWA World Airlines advertise that more than half their transatlantic passengers now are women, and that this has only been so within the past few years. Furthermore, they believe the trend will continue, drawing airlines serving New York right.

Lady Promoters

TWA in 1952 started a trend in airline women's promotion by creating "Mary Gordon," travel advertisement name for its special women's service. Mary's advice refers now include Lady Sobers and her family of Madonnas, including Sally Simpson at Southwestern Airlines System and Kaye L. Brenner of KLM Royal Dutch Airlines, who usually goes by her real name at Anika Bagard.

TWA's own Mary Gordon was the "very first" in the field of special services to women travelers, but Pan American's Jane Kilbourne (and name) claims a first in women's promotion generally and says her airline was first in creating the feminine portrayal of the market.

Most airlines today promote air travel, and their own companies, by speaking to women's groups, serving fashion shows, discussing travel in relevant interviews, demonstrating how to pack for a trip, appearing with special department store fashion presentations, and other. Beyond these basic devices, their special invitations and special offers, very considerably. Examples of how they are handled:

- TWA has five Mary Gordons operating in the United States, all under gay girls dressed in elegant, sophisticated, and fun. Gail Garlock heading the program from New York is director, women's department. The program began five years ago with one Mary Gordon. TWA's advertising campaign features the service and special incentives to Mary Gordon. The ads draw as many as

6,000 and responses a month, according to Miss Garlock.

A lot of the letters come from men.

A top pull has been an ad showing tips on how to get ready for a trip to Europe. TWA also produces 12 books in connection with its Mary Gordon service, with tips on such matters as international clothing, traveling alone, what to see and what to buy, how to plan a travel wardrobe. Special programs have included Mary Gordon tours of Europe, special dinners of food and fun given over TWA's international system.

• Pan American's women's promotion is headed entirely by Jane Kilbourne, who began her program in 1946. The airline took no advertising space for the women's angle. Miss Kilbourne works through editorial teams, press releases, special programs arranged through department stores.

She makes use of personal appearances in one-to-one sessions, a work at a Seattle clubbing room as travel advisor during a special presentation. Typically, she does five editorial reviews in the local press. Miss Kilbourne also works out contract arrangements with magazines which result in good publicity for Pan American.

Elaine Smith, the April editor of "Seventeen" Magazine, says American Airlines, with the airline promotion editorially based in pictures and copy.

Miss Kilbourne hopes to see an expansion of Pan American's women's promotion activities, with additional representatives to cover women's clubs.

• KLM started its program in this country last December under its new director of women, Miss Bagard. She, like Miss Kilbourne, handles the whole show. The program consists mainly of contacting women's groups, spending on special outings from the train to the airport, discussing travel in relevant interviews, demonstrating how to pack for a trip, appearing with special department store fashion presentations, and other. Beyond these basic devices, their special invitations and special offers, very considerably. Examples of how they are handled:

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to membership in the club, which is held among its members the entire to high noon and leaves at 10:00 a.m. and downtown location in lower Manhattan city. The airline's quarters at New York International Airport's new lounge, others featured, scheduled to open this year, will contain club rooms.

The members also receive various personal attention from "Mademoiselle Sobers" representatives stationed at most cities on KLM's international network. Miss Kilbourne, who heads the Lark Sobers program in this country, reports a membership of 5,000. Miss Kilbourne handles other U.S. women's promotion including the standard TV, fashion and packing demonstration ideas.

- Northwest Orient Airlines has just announced its new "New West" women's service, with Martha Christie as Northwest's spokeswoman to attract women among its passengers. New West will provide the usual travel aids, the fashion, fashion and travel tips. The airline refers to its service as "women's travel." • SAS started its "Sally Ann Simpson" program in February, 1956, under the guidance of Mrs. G. G. Simpson in addition to fashion, TV, women's clubs and other promotion the airline's women's service will include a series of 12 shopping guides for individual countries on the SAS routes. One of the airline's club has been produced by Miss Gantman is writing a weekly planning book for lady air travelers.

Domestic Hand Sell

Compared to this international general promotion geared at women by the international airlines, most domestic airlines so far are following more of a back-of-the-envelope approach to the market as an individual prospect here.

- American Airlines will a few months ago had only one contact's representative, Mrs. Alexander Stevens, who headed the program for about six years. These are now women under American's direct sales office at Washington, Los Angeles, San Francisco, and Chicago, and there is an uncoordinated program. Miss Stevens operates chiefly by contacting the heads of women's groups. For example, she recently contacted the Social Service Association of the country, after by asking ladies to Social conventions or by planning or travel by other means where American routes are not needed. The airline does an advertising directly to women. Its information are called special sales representatives rather than women's promotion.

• United handles its women's promotion on a divisional basis. Each

of the carrier's five divisions has one women's representative in its sales office. Their work, however, includes sales promotion generally as well as women's efforts and they are called "managers of special events." Events include the subscription fashion show and radio and TV appearances.

While there is a general agreement that the women's market is an increasingly important factor in airline travel, attention to appraise it as not absolute. Some companies that limit at the range of the market.

• TWA has a special survey of its transatlantic passengers last summer. Based that women comprised 57% of the total, 50% of the transatlantic traffic. Another year survey in February showed that women comprised 57% of the total, from which TWA concluded that it would move men to winter, more women in summer. Domestically, women comprise about 44% of its passengers.

- U.S. Department of Commerce Bureau reported 1955 passport applications 106,913 total, 65,912 female. By 1955, women were making up about 58% of applications compared to 57-58% male applications.
- Passport office of the State Department reports that 56.5% of 1956 U.S. annual travel was women. "Travel" is defined as a person covered by a passport.

• Port of New York Authority, serving overseas departures from New York International Airport, found about half of the American women were women. As earlier Port Authority survey of domestic passengers found about 10% women among departures from the three New York airports during 1956. Why are women making up proportionately greater numbers?

- These are major reasons, including:
 - Most of the income in air travel is in the pleasure, rather than business, category. Only a small minority of airline air passengers are business-like, increasing pleasure travel means proportionately increasing women riders.
 - Women are less reluctant to travel alone.
 - TWA estimates that a third of its women passengers to Europe are as first class. The airline's special activities in persuading women for women probably have helped this trend.

• Most women are working and have the money to travel. In 1943, 13.5 million women held paid last year, the figure rose 21.2 million. Comparable increase in men was from 16.8 million to 45.4 million.

• An air travel becomes increasingly as useful as safe and comfort, more women are trying it.

Another reason for pricing low prices is women's influence on the way the family budget, including vacation money, is spent.



Germans Fly Turbo Prop Liner

Germany is making its first postwar bid to enter the transport aircraft market with plans for a medium range, 54 passenger transport powered by two Napier Turbo-prop engines.

The aircraft, designated the HFB-200, has gone through the first design stages and is being adapted to the twin-engine market in either a short haul, high density airliner or as a long-range executive type aircraft.

It will be built by Henschel Flugzeugbau at Hamburg-Finkenwerder, Germany which has constructed no aircraft since the war but produced the first engine.

Deutsche Luftfahrt AG, responsible for German aircraft production and service during the 1930s.

Although the company has designed the HFB-200 with Napier Turbo-prop 1,600 hp engines, it is also planning to build a 1,300 hp version. The company is also planning to build a 1,300 hp version. The company is also planning to build a 1,300 hp version.

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• An air travel becomes increasingly as useful as safe and comfort, more women are trying it.

• Crating speed at 20,000 ft. is 277 kts. rate of climb 5,000 ft. per min. It can cruise. Service ceiling 34,000 ft. Takeoff distance 1,150 ft. Block speed is 248 kts.

According to the company, the aircraft, equipped with the Allison 501-D 13 turboprop, will have a cruising speed of 500 knots. Rate of climb will increase to 5,000 ft. per minute and the service ceiling will be raised to 35,000 ft. Block speed of this version will be 271 kts.

CAB Office Complaint Cites Pan American

Washington—Civil Aeronautics Board commissioner office has issued a complaint against Pan American Airlines charging the airline with "unfair methods of competition as air transportation and traffic relations."

In a petition for enforcement, the commission office said that, based upon information received during an administrative investigation, Pan American unjustly violated the Civil Aeronautics Act through payment of excessive or improper compensation to its agents. The office also contends that the airline charged less compensation for cargo transportation than the current effective tariff.

According to the CAB staff, Pan American has, since Jan. 1, 1956, and earlier, attracted or permitted foreign travel agents to sell or obtain 10% commissions on rates of roundtrip first-class and tourist air transportation in use of the usual 75% on roundtrip first-class and tourist fares and 10% on authorized rates.

The staff also charges that Pan American has accepted from New York shipping companies rates on space around weight which the international weight rule, which provides for a higher rate, was applicable.

SUD-AVIATION CARAVELLE



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ing the first six months of the year, a 16.6% increase in both categories over the same period of 1956. During June, the carrier flew 16,580 passengers, 1,143,600 passenger miles, an increase of 10% for both categories over June of last year.

✱United Airlines plans to file for a 10% increase in its air freight rates to become effective Sept. 1, subject to Civil Aeronautics Board approval. The new rates would not apply to carriers whose rates are set by law, such as the airlines, and would not apply to domestic routes, which would be raised only 5%.

✱Air France will fly a pilgrimage to the shrine of Lourdes, France, on a tour sponsored by the Catholic Travel Office of Washington. The tour, sponsored by Edward Cardinal Mooney, Archbishop of Detroit, will leave New York on Sept. 25, spend a week in Lourdes, fly to Rome on the morning of Oct. 2 and depart that evening, arriving in New York the next morning. Price of the tour is \$695.

✱North Central Airlines established a new local service weekly, passenger route by carrying 63,951 passengers over the previous industry record was 56,467 passengers set by North Central last August. During the first six months of 1957, North Central carried 304,883 passengers, a 19% gain over the same period of last year.

✱Trans-Canada Air Lines has begun the first morning transcontinental service in Canada by linking Toronto and Vancouver with Lockheed Super Constellation. The service is connected with New York by TCA.

✱Alleghe Airlines set a new monthly record by flying 7,141,475 passenger miles during June. In the first half of 1957, Alleghe flew 28,103,000 passenger miles, an increase of 17.6% over the same period in 1956.

✱British Overseas Airways will move Caribbean dispatching on all flights over U.S. territory, replacing French men and changing previous record.

✱Douglas Aircraft Co. will begin delivery of last models of its line of giant Douglas DC-6A to Lake Mead National Airport during the third quarter of 1957. Approval of two bank orders totaling \$4,291,000 by the Export-Import Bank paved the way for the sale. The aircraft will be equipped for operation in combination cargo and passenger airlines featuring such adjustment of the interior space to accommodate the varying relative volume of passenger and cargo traffic.

AIRLINE OBSERVER

✱Look for Canadian Pacific Airlines to be given an opportunity to compete as well as other domestic routes against Trans-Canada Air Lines. Canada's new relief bill, the last Conservative government in 22 years, is expected to open the airline's routes to C.P.A., which presently operates domestic routes only on a non-scheduled basis in addition to its global international routes.

✱New York Airlines late this year will ask helicopter manufacturers here and abroad to submit bids on a 25-passenger, two-engine turbine engine utility helicopter. NYA has been working with other air helicopter operators to develop a block of orders of sufficient size to make it worthwhile for manufacturers to proceed with the development of a new design. General Electric's T56, which is expected to go into production in 1958, appears to be leading contender as powerplant for the new helicopter wanted by NYA.

✱International Air Transport Association will refer the issue of transferring its headquarters from Montreal to Geneva to the association's general assembly which will meet in Madrid on Sept. 10. Plans to move rank from decrease by European nations for a headquarters closer to their bases of operation.

✱Flying Tiger Line has received a \$9 million contract from the Military Air Transport Service for the transportation of military personnel and freight between the U.S. and Japan. The six-month contract is renewable on performance and can be expanded up to the first capacity of the airline. It apparently will fly 510 flights monthly, the airline has assigned three of its fleet of 12 Lockheed L-449 Constellation to the Pacific route but expects to increase the number to six during the next two months to accommodate MATS traffic demand.

✱Scheduled helicopter operations between Dallas and Ft. Worth were inaugurated by Helix Air Transport last week with an air parcel service between the two cities. Helix will operate three roundtrip flights a day with Bell 47J11 equipment. The carrier has an application on file with Civil Aeronautics Board for a non-scheduled passenger, cargo and mail certificate, and its scheduled air parcel service will provide experience which will be valuable if Helix desires to go into passenger operations.

✱Civil Aeronautics Board has set final procedural steps in the Suspend Passenger Fare Increase Investigation with both due on July 24 and oral arguments scheduled for July 31.

✱United Airlines today began a joint scheduled flight service with Canadian scheduled flightlines to provide air cargo service to shippers located in areas which do not have direct air service. The routes will cover more than 900 miles in 16 states regularly served by Constellation.

✱Civil Aeronautics Administration has proposed new runway layouts that will permit transport aircraft to turn off runways 80 to 45 seconds after touchdown. Taxicway will be provided at an angle of 90 degrees to the runway under the new layout design, with a series of taxiway strips to accommodate both short and long landing aircraft. The layouts have been developed as standards by the CAA for use in the Federal Airport Act Program.

✱Elwood Gurnea, newly appointed special assistant to the president for aviation facilities under a special tour last week of the Civil Aeronautics Administration's Federal Development Center in Indianapolis accompanied by American Consulate Services, Louis R. Ruffalo and CAA Deputy Administrator William Davis. At the same time, 10 CAA officials including Administrator James Felt met with representatives of the Canadian Department of Transportation in Ottawa to review areas and airports of mutual interest of the two countries.



"Duke" French, outside Friendship International Airport's Terminal Building. Directly behind him is a Constellation operated by Eastern Airline, one of Pan-Maryland's airline customers.

"There's no ceiling on success when you fly with Shell!"

says G. B. Fenwick, Jr., President of Pan-Maryland Airways. P.M. boosted its gallonage fiftyfold in six years as a Shell Aviation Dealer at Friendship International Airport, Baltimore

It's no wonder Berris Fenwick is happy Pan-Maryland teamed up with Shell in April 1964. At that time, one truck was more than enough to handle their business. Three months later, thanks to Shell's help, they began making in-flight deliveries to the airlines.

Today, Pan-Maryland has 13 trucks busy fueling and servicing the airlines, private airplanes, jet fighters of the National Guard, police department aircraft, helicopters, military

and government-owned aircraft and dozens of corporate aircraft.

"We've got an extremely diversified operation here," says Berris. "Pan-Maryland handles everything from Cessna to F-4 Navy jets—from Miles to B-52's."

"Consequently, we handle the complete line of Shell Aviation Fuels, including Shell Turbine Fuels for jet planes and commercial turboprop airplanes.

"Shell also provides us with a full line of AeroShell lubricants, fluids and greases to fit our customers' needs. What's more, we get up-to-date technical advice from our Shell representative who's always at our service."

When Berris talks about the services Pan-Maryland gives its customers, he emphasizes that delays are almost nonexistent. All pilots have schedules to meet and what they want most of all is fast, efficient, on-schedule service.

A "Customer's Service Report" is mailed to every flier who stops at the field. It invites comments and criticism of service, workmanship and courtesy. Replies like "Best service I've ever gotten—anywhere," "Excellent in every way," "Keep up the good work," are received every week from all over the country.

Berris points out that their CAA Certified Repair Station is going to be finer than ever. A big new hangar will be completed soon and he plans a Class 4 shop there, with service crews qualified to work on every type of plane.

Other plans for the future include branching out into airline ramp service, setting up an aircraft sales department, building more hangars and boosting gallonage still further.

"After all," says Berris Fenwick, "the sky's the limit with Shell."

It pays to be a Shell Aviation Dealer
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Private planes get best class treatment, too. Every civilian pilot who uses the field receives a "Customer's Service Report" which requests suggestions for improving service.



The Boeing 707 jet transport is fueled by Pan-Maryland with Shell fuel at Friendship International Airport after its most recent 3-hour, 46-minute transcontinental flight.



Berris discusses plans for future expansion with Col. J. Coleman, Airport Director.

M-W Wings Sidestep Drawback of Sweep

J. S. Davis, Jr.



DEMONSTRATION model to illustrate effect of leading and trailing leads on a swept-back wing is shown in sketch position. Long bar on wing tip emphasizes its angle of incidence. Colored cross through wing is elastic or trailing lead (arrowed), so that wing twist will be shown by relative movement of the airfoils.



FURTHER leading lead (arrow) acts through the elastic axis causing no wing twist. Thus it shows by curved angle along the elastic axis with the airfoils that no twist occurs. However, incidence of the wing tip is reduced causing loss of lift in that region.



TYPICAL incidence lead acts ahead of elastic axis. Wing twist indicated by the oil stain leads to increase the angle of incidence and counteract effect of the leading lead. It is difficult in practice for trailing lead to overcome loss of incidence due to twist.

New York-Tina planning through somewhat independent wings having M and W shapes are being tested in the U.S. for use on large, heavy transports and bombers designed to cruise at supersonic speeds.

The M wing sweeps forward on the inboard panel and back on the outboard, the sweep is mostly the opposite for the W wing. Basic idea is to retain the drag benefit of sweep while eliminating the aerodynamic problems which is the most serious drawback of a swept wing.

Ideal Shape

Delta, swept and straight wing planforms have been successfully used in a variety of aerodynamic research to perform a number of specific tasks, and later aerodynamic research for the solution. Designers inherent in each present design from applying an ideal shape, and are sure that all three may be passed over for very large planes operating at high altitudes and supersonic Mach numbers.

The story of the original idea of these wings is a familiar one. The Germans suggested and used instead of M and W wings in the early 1940s when they were very ahead of the rest of the world in transport and supersonic aerodynamics.

NACA started work on these wings in this country, followed by a 1948 memorandum by R. V. Rhode of the Langley Laboratory. The problem of swept wings was more completely defined at this time and Rhode showed there were considerable structural possibilities in M and W wings, counteracting previous depiction of their weakness.

Drag Question

Earlier objections to the wings also emphasized the poor drag qualities of the structure of the swept panels. However, that work was begun on the strength of the aerodynamic potential NACA is still working with M & W wings not much of the causal subject arises and they use with one rate and other means of reducing the drag of wing-body combinations.

If transport cruise speeds continue to increase at the same rate they have for the last 10 years, there is a 1,000 mph (approx. Mach 1.5) jetliner will be flying around 1968.

Estimation of what the most economical transport in this class will be like



IN-WINGED configuration that meets ground requirements for transport with supersonic cruise speed. M wing is superior in shape swept wing in aerodynamic and stability characteristics.

have been made by R. T. Jones of the NACA. It will probably have a wing leading similar in present day transports, with comparable leading speeds, though it will fly at much greater altitudes where these wing loadings are more economical.

Reduced air density at this altitude means the structure would have to be strong and for a swept cruise speed of 300 mph.

Aerodynamic loading would also be negligible under these conditions. The aircraft would have to be carefully constructed in its performance and maneuver at lower altitudes where the air loads would be much greater than at cruise height.

As for the wing in reversed, Jones' most important point is that the relative axis of the leading and wing will remain such as they are on current aircraft.

The wing will also continue to be used and shown with high aspect ratios for supersonic as well as subsonic theory indicates that this is not for good cruise performance when the wing is

contributing to the support of the aircraft.

This requirement for a long narrow wing is the one which makes one of our best wing shapes difficult on the supersonic transport.

• Delta wing becomes moderately large when it is given a wide span and high aspect ratio.

• Swept wing is restricted to a short span when it is then required to have low aspect ratio. This is because structural strength decreases rapidly as the wing thickness decreases, introducing

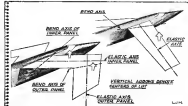
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SKETCHES show location of leading and elastic twisting axis on swept wing and M wing. Lower part of M wing acts in single perpendicular wing which experiences an elastic incidence from leading lead due to lift. This can be counteracted by reversing the wing shape. Here leading lead gives the opposite effect of lift on perpendicular wing. On the M wing the incidence is in addition on the perpendicular system is counteracted by the extra panel lift which gives the outer panel a nonuniform twist. This is the basis of M and W wing theory which the NACA feels will almost eliminate the adverse aerodynamic effects of swept wings.





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at the tips also affects wing tip stream velocity.

Thenceforth, and with considerable experimental verification, these advantages are attributed to M and W wings by the NACA.

• Pick-up and break stability problems of swept wings are greatly improved, if not eliminated, by proper M and W wing design.

• M and W wings generally have more drag than a conventional swept wing at subsonic and transonic speeds but at low supersonic Mach numbers the swept wing advantage disappears.

• M and W wings are lighter than a swept wing of equal aspect ratio and bending strength. For a given weight of wing structure, they may be built with a greater aspect ratio and therefore better range characteristics.

Incidence Unaffected

Most important feature of M and W wings is that wing incidence is not affected by bending in turbulent loads, eliminating one of the two causes of pitching.

The mechanics of low M and W wings advise that can be seen in the diagram of the M wing. The inner panel acts as a simple swept forward wing which experiences an increase in wing incidence due to its lift load. This increase in incidence due to bending is obvious if wind direction is rotated on the sweptback model on page 50. The lift on the inner panel also acts to increase tip downwash because of its lift

LOW-SPEED model (above) and high-speed model (below) are typical of those used by the NACA in M and W wing investigations. Both possess built-in conventional various line tools of sweep discontinuity and horizontal tail position.



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speed action around the inner panel's elastic rim. The elastic is wing and does increase lift increases and vice versa. The tendency of a swept forward wing is self-correcting using the concept is the person sense of its disadvantage is a useful wing type.

On the M wing, this nose-up tendency of the swept forward panel is counteracted by the lift and so the postulated action which gives a nose-down movement around the inner panel's elastic rim. The outer panel thus acts like a separate sweptback wing. Its loss of tip incidence due to its own bending will be low because of its short span. Thus, too, it will be possible to counteract any loss of incidence on the tip of the outer panel by allowing the whole outer section to rotate around the elastic rim of the inner panel.

Value to Designer

The interrelationship between the two panels and their loads and structural properties gives the designer a much larger number of controllable variables than he has on a pure swept wing. The NACA tests show that the M and W plan forms will show enough control over wing loading and bending character when their wing incidence will not change substantially through an aircraft's whole range of flight speeds and attitudes.

Boundary layer growth, the other cause of pitch-up and lateral instability, is also reduced on M and W wings. The length of the swept surface is much shorter than on a simple swept wing of equal span and the boundary layer has less run in which to thicken. This lessens the danger of separation.

In every experimental comparison the M and W wings were superior as pertain to the swept wing in lateral and longitudinal stability. The M wing proved generally better stability-wise than the W at all speeds (Mach numbers at 3.4 was highest tested) and at all lift coefficients.

Conversely very high drag details arose oncoming at the junction of the outer and inner wing panels where the sweep sequence did not really materialize.

At subsonic and transonic Mach numbers M and W wings both were drag less than a similar swept wing, but they have much less drag than a straight wing of equal thickness. This shows they are a much of the benefit of sweep. In most cases this amounts to about 85% of the drag savings possible with a pure swept wing.

At low impedance speeds M wings are roughly comparable to similar swept wings in zero lift drag, while W wings are cut in efficient. The W wing also has greater drag at high lift coefficients in the transonic and low impedance speed range than the M wing and swept

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wing. Swept and M wings are nearly equal in this respect.

The junction where sweep changes may actually prove to be a drag benefit for M and W wings. Placing engine nacelles or other bodies at the junction gives more depth for structure in the highly stressed region and if properly shaped may improve the Reynolds number flow conditions in such a region. The pressure losses at the junction would also facilitate the incorporation of boundary layer control systems over the whole wing type.

The opportunity to spread the air craft volume out by giving large bodies at the wing junctions can aid in cruise type drag reduction studies. Studies of this type are being conducted by the NACA.

Other Composite Wings

Several other types of composite wings have been proposed that would allocate the aerodynamic and high-speed stall qualities of the swept wing. One is the control wing, also conceived in Germany, in which sweep back angle is decreased towards the tip. This places the outboard sections well ahead of the elastic axis of the wing. The tip load then tends to increase wing stiffness and counteract the loss of resistance due to the leading edge of the highly swept portion. Tendency to tip stall near boundary layer build-up is reduced because of the smaller angle away of the tip. Major drawback of this type is the very thin section needed at the tip to make up for loss of sweep.

The semi-rigid wing is another variant in the problem of swept wings. This wing, conceived by G. T. R. Hill in England, is intended to maintain a constant resistance under all design loading conditions. The main wing structure is placed well back in the wing so that the elastic axis is near the trailing edge. The raised flap tends to apply a greater torque to the wing to oppose the loss of resistance due to bending.

This type of wing requires great bending strength in relation to its structural strength which is often difficult to achieve. Under these structural conditions conventional aluminum are not as attractive in solving wing tip controls.

M and W Disadvantages

The large number of structural variables which allow control of the M and W wings aerodynamic qualities also have the disadvantage of greatly complicating the task of wing design. These considerations of the problems in the wing under all flight conditions is also complicated by the compounded many knowledge of types loads is most critical on the M and W wing of each panel is to react properly and the complete wing.

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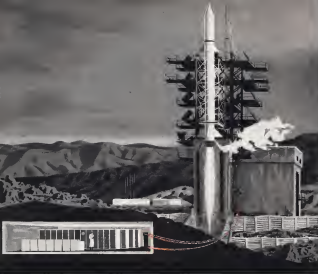
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O-Ring Valve Used In Manned Rockets

Tombey, N. J.—High pressure valve using an O-ring seal has demonstrated such reliability that it is being incorporated in the valves for several manned rockets. North American X-15 is the only such project revealed.

Principle of operation relies on the relatively insensitive to manufacturing tolerances and reduces its own weight. These features plus the very low sealing and operating force required (about 6 lb. in a 5,000 psi line) have brought close attention from several government and aerospace manufacturers.

Normally high pressure valves must have tapered seats lined with a hard surface. Manufacturing is eased by steel seatless and light tolerance action and proper installation requires considerable skill. The new valve, called the "respline seal valve," has succeeded in maintaining a constant force on the O-ring seal during the opening process and preventing it from blowing out under high pressure. This blowing out problem has, until now, prevented the use of the expensive O-ring in a high pressure seal.

The new valve was designed by the Buege Research Engineering Corp. with the operation installed in Peter H. Pica of that organization. The Buege group is a small company, formerly a subsidiary of Aircraft-General which conducts its operations in original design and development work. Financing derives are licensed for production.

Buege has licensed a subsidiary, The Buege Capital Seal Valve Corp., to develop further the new principle and has assigned production rights to development. Technical Division of Robertshaw Fulton Controls Co. Other than Buege product is a line of very small, shock resistant pin switches. Company research projects range from having submersible cable to remote properties.

AVIATION WEEK, July 15, 1967

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HYATT

DAN Rockets Will Correlate Solar Flare, Radio Fadeout Data for IGY

De Russell Macken

San Nicolas Island, Calif.—First U.S. socket firing of the International Geophysical Year was made from this area on the offshore range of the Naval Air Missile Test Center, Point Mugu.

It was the first of a series of 14 EPR spectra—Deason's sophomore with Naval Academy—taken by the team in the Naval Research Laboratory in an effort to correlate ultraviolet, X-ray and gamma emissions of solar flares with solar flare-out due to increased electron density in the magnetosphere.

Sea Nicolas Island is 15 miles closer to the mainland than the other islands.

The first sheet was subjected to record normal background signals in the ultraviolet, X-ray, and Gamma bands as baseline for comparison with signals recorded during flares.

Commission Link

Observations at Clammy, Colo., Sycamore Peak, N. M., and Mount Wilson, Calif., will observe the sun closely during the tests. Expected astronomical events will be the appearance of sun whether a flare is high. There is a direct telephoto connection between San Nicolas and Sycamore Peak. Mount Wilson and Clammy have radio links.

Fast communication allows the allomeres to notify the San Nicolas group that a flare has begun in time to get under aloft for maneuvers. Signals on an radio frequency between nine and 17 megacycles are

monitored for lake-level reduction of flow.

Die Prozeduren er-

Firing Sequence

It will take about one minute to determine that a flare is actually burning and about three minutes to get a pump, channeur, warm up the instrument, check out the telescoping equipment and firing controls, then the pad crew can fire the rocket up into the atmosphere. Flares may reach their peak intensity in about five minutes.

Trudman says it may be possible to cut the checklist separate to both very dry, rugged

The nickel-titanium sale of springs is being handled by technicians from Cooper Development Corp., which also holds the various contract for assembly of the coils and manufacturing of special equipment. Cost of project is \$190,000 exclusive of salaries for NRL personnel.

The low figure is made possible largely by Cooper's use of two Nike Agen boosters and obsolescent Douglas rather than more costly modern high performance systems.

The estimated cooperation would cost

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will be this project because the areas non-phenomena of interest to the NRL scientists occur chiefly in the D and E regions of the lower atmosphere.

These regions are in the stratosphere between 50 and 70 miles and within range of the Nike-Deacon which is capable of about 80 miles in the configuration being used. It takes 90 seconds to reach an altitude where useful measurements can be made. Records can be taken for two or three minutes before the rocket falls back into dense, radiation attenuating air.

Flight Duration

Duration of last week's flight was four min, 50 sec from launch to on set of the Deacon. The mission was between 73 and 80 miles. Dr. Friedman exposed stratification with the aid of the test on the basis of a peak glance at the data. No X-ray signal was recorded.

This establishes the fact that there is some place in the air where activity on the side of the sun toward the earth. Some doubt of this was created when a Rocketeer fired but you recorded X-rays during a fire, considered too small to produce radiation reaching the earth.

Instruments at the present project's rocket measure ion X-rays on the ion length range from one to six angstroms. Another Geiger counter is set to detect ion X-rays of 5 to 10 angstroms.

Low Ultra-Violet Level

Quick examination of the record of the baseline test indicates a lower ultra-violet level than expected. The NRL scientists here not yet determined whether this is caused by a low output from the sun or because all part of the sun from the rocket. Analysis of the record from a photo at the rocket will make it possible to determine what the effect was.

The rocket was designed to slow roll at a rate of about 30 rpm. A certain amount of sun was anticipated and necessary to bring the sun within the field of the detector which was concerned looking out of the sides of rocket.

Time between points registered by the sun and the horizon on the photo cell record are used to calculate roll and spin.

Ultraviolet measurements are taken at the Lambda-Alpha Line—1216 angstroms. This wave length has special significance in solar studies as it is the resonance line of hydrogen, the most common substance in the sun. The Lambda-Alpha Line is quite sensitive to about 0.1 angstrom. It is so the ion quency range called Vacuum Ultra Violet zone it is completely absorbed by a few inches of air at sea level density.

WHAT'S NEW

Reports Available

The following publications are available from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

AEC Research Reports Price List No. 22—Available without charge. Contains over 3,000 AEC reports in the OTRS collection, 474 of them reported since June 30, 1956.

Survey of Low-Alloy Aircraft Steel Heat Treated to High Strength Levels. Part 1—Factor Causes—by G. S. Scales, Squawac University for Wright Air Development Center \$2.00, 90 pp. (PB 121607)

Prevention of Mechanical Vibrations in Electronic Circuit-Design Manual—by W. F. Stokely, C. E. Ziemer, and F. C. Apple. Carnegie Institute of Technology for Bureau Air Development Center \$2.50, 96 pp. (PB 121564)

Effects of Specimen Preparation on Fatigue—by F. H. Vitaras and H. J. Brander. University of Minnesota for Wright Air Development Center \$1.50, 53 pp. (PB 121570)

Skip Chipping of Poly-Fil Joint Under Load in Varying Penetration—by F. H. Rupp and L. E. Goodman. University of Minnesota for Wright Air Development Center \$1.25, 47 pp.

Investigation of the Composite, Bearing, and Shear Properties of Aircraft Structural Materials and Low Temperature—by F. J. Weaver and others. Cornell Aeronautical Laboratory, Inc. for Wright Air Development Center \$3.50, 95 pp. (PB 121576)

Fatigue, Creep, and Resilience Properties of Heat Resistant Materials—by F. H. Vitaras and H. J. Brander. University of Minnesota for Wright Air Development Center \$3.50, 213 pp. (PB 121550)

Rate of Information Transfer with Seven Symbolic Visual Codes: Motor and Visual Responses—by E. A. Nelson and F. F. Miller, Jr. The Ohio State University and The OGI Research Foundation for Wright Air Development Center \$1.00, 35 pp. (PB 121718)

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WIDE ANGLE CAMERAS are mounted in wingtip pods of KDA Firebee (left above). Remotely controlled camera stored back of fuselage as it approaches the target. Smoke generators are mounted under Firebee wings to provide absolute visual identification (right)



Radar, Smoke, Flares Identify Firebee



INFLARED FLARES attached to Firebee's engine exit heat-shielding heat-seeking weapon to home on the target drone.



RAZAR REFLECTOR mounted in tail of Firebee (left) corners wings at which the drone can be "seen" by radar tracking equipment. Redden lights on wing tips of Firebee (right) apparently get rid of radar "detection," almost heat-seeking missiles.



Detectability of KDA Firebee enhanced target drone is increased by radar reflector pods; infrared lamps and flares and smoke generators to simulate large, multi-engined jet bomber. Radar reflectors may be used corner reflectors or L-shaped beams composed of concrete layers of radio frequency reflective plastic. Reflectors must be oriented to meet attack from any direction.

Radarless drugs is complicated by use of ground, airborne and mobile radar operating on different frequency bands. Strong signal may also be produced by putting under beams in drone to be triggered by pulse from attacker's radar, but true big in between operation mission range cross under compromised.

Jet efflux of engine exhaust can be simulated to aid heat-seeking by missiles. Infrared exhaust flame has the advantage of leaving no residue. Its long periods but its energy is concentrated in a narrow beam. Flare is less directional but has short duration. Camera mounted in tip pods with overlapping fields covered line of approach of missile. Closest point can be computed by triangulation in image comparison.



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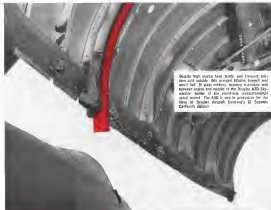
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DECTRA PLAN for the North Atlantic. Approximate every 100 lines of tracking patterns are shown and every 100 lines of ranging pattern. Accuracy contours relate to range errors only; track errors will be less.

Deetra Begins Vital Atlantic Evaluation

By James A. Fagan

Evaluation tests on Deetra, a highly accurate British long-range hyperbolic navigation system, have begun over the North Atlantic. North Atlantic air routes between Canada, Newfoundland, and Portugal, are being tested.

Deetra is expected to reduce present range errors standards from 120 miles today and 10 minutes long, to 10 miles and 10 minutes, respectively, according to Deetra Nav-gator Co. which developed the system under British government sponsorship. Pacific Division of British Overseas Airways, which holds U.S. home rights to the British Deetra system, is expected to give formal U.S. rights to Deetra this year.

British Aid

Successful results in the current tests will greatly strengthen the British bid for adoption of Deetra by the International Civil Aviation Organization as the standard long-range navigation system. The official U.S. contractor, Navstar, is undergoing performance tests by the Rome Air Development Center, but reportedly is lagging behind earlier schedules.

If the Deetra system fulfills its promises, navigation facilities of other long-range systems, such as Navstar, Loran C (Cyprus) and Radio U.S., may be combined with a fast accuracy by a navigation system already in use over the North Atlantic.

The in-flight Deetra evaluation program is under the joint support of the British and Canadian governments and will include participation by several in-

ternational airlines. British Overseas Airways, Trans Canada, Pan American, Scandinavian Airlines System, KLM, Royal Dutch Airbus and Seamer reportedly have indicated a desire to participate.

A British Ministry of Supply four-jet Vickers Valiant bomber has been equipped for Deetra use and presently is making test flights under the guidance of the Newfoundland shore. Data will also be collected by passenger and weather ships.

Deetra is expected to provide some range errors of less than 100 miles up to 1,500 miles in length, the low frequency (70-75 Mc) hyperbolic Deetra system is expected to cut greatly the growing air traffic congestion over the North Atlantic, according to representatives of the British Deetra Nav-gator Co.

Deetra is expected to provide some range errors of less than 100 miles up to 1,500 miles in length, with range error being cumulative along the route and track error decreasing as both distances from the route and point.

Answers to two questions raised by navigation experts in this country and abroad will be sought during the trials first, can Deetra fit within the crowded

New York to London Deetra Coverage

Significant reliability of Deetra system from the Newfoundland Deetra data have exceeded expectations, opening the possibility that with the aid of a single transmitter in particular, range information will be required to Great Britain.

If in installation of a single receiver Deetra transmitter in the New York or Washington area would provide full Deetra coverage from many entire U.S. ports to Newfoundland using the "back" route from the Newfoundland station and hence to Great Britain using the "forward" route.



OMEGA FLIGHT LOG installed in cockpit of B-58, Ypsilanti. Decca Mark 18 receiver is capable of dual Decca and Decca operations with addition of Decca tape unit.

continuous simultaneous stage area and, second, will in three performance displays to screen of strong ground and air wave output.

Decca's development are optimistic about the anticipated results. Addressing a British Institute of Navigation meeting last Fall, G. Hawker of the Decca Navigation Company stated that, although much remains to be learned about Decca's comparative performance, company engineers do not expect to lose more than two or three lanes (lane lane width being 14 miles) in the course of a flight across the Atlantic.

Point to Point System

Decca charts comprised of a narrow and wide station pair normally will be placed inside each end of a proposed route. The two charts are aligned so that the hyperbolic position lines (lines of constant phase difference) generated by the phase-locked transmissions of each master and slave pair form a fan.



OMEGA FLIGHT LOG. For use in direct by worn gas, that by specific charts.

By of tracks between the charts, varying in separation from one mile and the approach (up to 50 miles at real rate). Range along the tracks is established by the phase relationship between the two master station transmitters.

Airborne Installation

The airborne Decca navigation system weighs approximately 140 lb., including the Decca Flight Log, a seven-disc chart storage and receipt display device with a 20-inch by 4-inch presentation. A continuous 16-inch Flight Log chart has been prepared for flights in each direction between Glendale and Fort Worth so that in-flight chart changes are unnecessary.

Of the 51 Decca tracks that fall within the 10-mile accuracy contour, the 15 tracks lying south of the point circle route normally will be passed by outboard aircraft and the 15 north on tracks by outboard aircraft.

In addition to the tracks to be flown, the charts include the Decca letters, mileage and bearings and coordinates printed in black. A latitude and longitude grid is incorporated in red. On the back of the charts, variable and the backtracking has been lowered on, an immediate direction pattern giving to formation on track bearing and distance to the nearest decca station. The plot would not then information to establish his direction course before changing to the small scale direction chart at one end of the route chart.

Approach charts, included at each end of the route charts, are standard Decca area coverage charts. The Decca letters are printed in color with a



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Decca control panel

See how RLE-121 Precision Submarine



TACAN-PORTAC receiver and control indicator

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See how RLE-121 Precision Submarine

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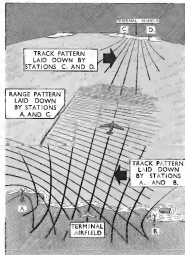
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DECCA RANGE and track patterns showing in diagrammatic form layout of Gander, Newfoundland, and Prestwick, Scotland, Decca chains

black, viewpoint of approach and topographical information.

Decca is an outgrowth of the sea distance Decca navigation system in use throughout much of Europe. The two systems are highly compatible and their installations seamlessly will be integrated. The master and slave pair working as the Decca installation in Newfoundland, for example, also serves as two of the four stations of the Newfoundland Decca chain known as Mecca East.

Decca airborne equipment demonstrates similar compatibility. The present Decca Mark 10 conforms with the addition of a Decca range unit is capable of dual operation, permitting a pilot to choose Decca for long-range, point to point navigation and Decca

for high-accuracy area coverage near the terminal.

The close interrelation of Decca and Decca slave bases Decca's methods of pattern generation and line identification. Decca is based upon the phase comparison of continuous wave transmissions from a master and three slave stations. Because the slave station signals are phase-locked with those of the master, phase patterns or "beams" are produced by each master and slave combination to form an overlapping area directional navigation grid.

Decca Fundamentals

The four Decca transmission frequencies are harmonically related to a fundamental frequency F (approximately 14 kc). The master station transmits at

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2053	30	1,200-2,000	28.00	26	30-35	MIL-1
2054	30	1,200-2,000	28.00	26	30-35	MIL-1
2055	30	1,200-2,000	28.00	26	30-35	MIL-1
2056	30	1,200-2,000	28.00	26	30-35	MIL-1
2057	30	1,200-2,000	28.00	26	30-35	MIL-1
2058	30	1,200-2,000	28.00	26	30-35	MIL-1
2059	30	1,200-2,000	28.00	26	30-35	MIL-1
2060	30	1,200-2,000	28.00	26	30-35	MIL-1
2061	30	1,200-2,000	28.00	26	30-35	MIL-1
2062	30	1,200-2,000	28.00	26	30-35	MIL-1
2063	30	1,200-2,000	28.00	26	30-35	MIL-1
2064	30	1,200-2,000	28.00	26	30-35	MIL-1
2065	30	1,200-2,000	28.00	26	30-35	MIL-1
2066	30	1,200-2,000	28.00	26	30-35	MIL-1
2067	30	1,200-2,000	28.00	26	30-35	MIL-1
2068	30	1,200-2,000	28.00	26	30-35	MIL-1
2069	30	1,200-2,000	28.00	26	30-35	MIL-1
2070	30	1,200-2,000	28.00	26	30-35	MIL-1

* For details see Bendix Generator Manual or literature for operation at 28 VDC.

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Red Bank Division of

is obtained generally by phase comparison of the F_1 beatnote of the received F_1 and F_2 signals with the F_1 signal derived within the Decca receiver by the dividing down of F_1 or F_2 . This provides an indication of constant range along a hyperbole whose foci are the two master stations.

Secondary Method

A secondary method of obtaining range is included in the receiver for periods when reception of the F_1 or F_2 signal is too poor to provide accurate two-signal range information. This system employs a high-stability crystal oscillator in the electronic equipment which is used to produce a frequency reference for phase comparison with which over-master station signal is being received.

The airborne Decca installation consists of:

- Flight Log
- Two control boxes: one provides receiver controls, the other Flight Log controls
- Three Decimators, plus a stage meter

One of the Decimators serves as the track indicator for Decca, all three are used for navigation by Decca.

Tracking System

The tracking system of the receiver can be switched either to the track pattern transmitted at (frequency F_1 , distances A and B of the distribution) or F_2 (distances C and D).

In normal operation the receiver will be set to the frequency of the chosen channel.

When F_1 is the received signal, one channel switch the phase of its F_1 oscillator while a second channel switch is a tracking circuit for the intervals when the slow transmitting to that the phase of the controlled oscillator and the slow signal can be compared by a decimator.

The output of the decimators causes the track meter in the Flight Log to indicate the aircraft's position line on the track pattern. The time constraints of the design decision cause an apparently continuous indication.

Measuring Distance

The two-signal ranging system is the primary method by which the system measures range. It requires the reception of the master station signals at both channels F_1 and F_2 ; above the receiver is set to F_1 , the subject of the phase-locked oscillator is divided down to derive the subcarrier F_1 at the master signal. The phase of the F_1 signal is compared with the F_1 beatnote of the master signal by a decimator as described above.

The hyperbolic pattern to which the decimator is set is a hyperbola

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Patented "Flying Beaver" Resinoid for the P-38's Lockheed NY 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

Bring your tough ones to Zenith

The great Rotadome was an engineering nightmare. It represented a whole new concept in Early Warning Radar equipment. Its airfoil shape and great size—36 feet in diameter—were a radical departure in radome design. It had to combine high strength with light weight, so that it could be rotated in place with the radar antenna.

Working in close cooperation with Lockheed's engineers, we made the Rotadome of roto-bonded glass fiber. It met every requirement for strength, weight, and electronic compatibility. And the entire job was completed—designed,

engineered, tool-d, fabricated, and delivered—in 120 days.

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FORM OF THE FUTURE: ROTO-BONDED GLASS FIBER

corresponding to one discriminator cycle of phase based on the frequency of the standardized signal because the component values of F_1 are chosen so as to cause them the phase of the F_1 transmitter and in the other case from the two signal beat-note.

Power Reception

The power when the reception of either master station transmission is lost goes to provide accurate range information, the receiver's stable crystal oscillator is used to generate the missing F_1 or F_2 .

In each case a constant range indication is obtained which occurs along a circle centered on the master station being received.

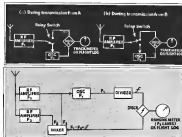
The output of the range discriminator drives a servo feed unit which operates a "feedback" effect to the servo motor, maintaining the speed of rotation during transmission loss of signal. A drive amplifier follows the servo feed unit which automatically selects angle-signal ranging upon loss of either master station signal. The outputs of both ranging systems are summed and can be converted with a velocity converter. The drift of the angle-signal range motion can be corrected during periods of two-signal reception by matching the output of the two ranging systems.

The simplified Dectra installation at Portsmouth requires the relocation of a class of the North British Dectra chain from Newcastle to a site near Solihull and an exchange of drive capacitors to make this the people short of the chain. A great circle lying along the median hyperbola laid down by the station and the Dectra master station (Dectra site) at Kalside passes approximately across the north of the Portsmouth and Gosport Airports. The Portsmouth Dectra chain operates on the purple frequency of Dectra Group 1 ($F_1 = 70.5375$ kc).

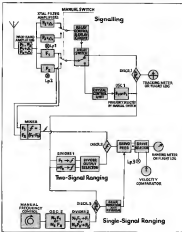
Dectra Sites

The Dectra site is Newbould and at Comfort Cove (Dectra master) on the north coast and at Thosha Lake (Dectra slave) approximately five miles south of Port Harland. This chain operates on the purple frequency of Dectra Group 2 ($F_1 = 70.184$ kc). The frequencies F_1 and F_2 are therefore the 40th and 49th harmonics of a frequency $f = 193.142$ cycles. The F_1 frequency will be controlled by means of the Cavendish Cave station at Kalside where it will regulate the master station crystal of the North British chain.

During the early tests the Dectra transmitters are being operated at 12 kw, however, they are capable of a maximum power output of 21 kw if test results indicate the increased power is required.



BLOCK DIAGRAM shows tracking system (top), two-signal ranging system (bottom).



BLOCK DIAGRAM of major elements of the Dectra receiver.



Cutler-Hammer Hermetically Sealed Aircraft Relays are designed to meet MIL-R-24400 (A & B) operating at 200 feet. Class A can operate in ambient temperatures to 115°C, Class B in ambient temperatures to 125°C. Class B are available with or without auxiliary contacts.



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Cutler-Hammer offers this ready-referenced design aid as a further service to the aircraft industry. Priced just below value of service rendered on parts, these ready design aids contribute to your design. Cutler-Hammer offices in every major U.S. city will be glad to write subject to manufacturer for complete information.

Cutler-Hammer Hermetically Sealed Relays set new standards in aircraft control

Cutler-Hammer Hermetically Sealed Aircraft Relays are the result of years of intensive development and research by Cutler-Hammer engineers in close cooperation with leading aircraft builders. Designed for use in higher ambient temperatures and better able to withstand shock and vibration, they meet both present and future needs for environment-free dependability. They offer longer life and contribute directly to increased safety.

Only permanent non-aging materials are used. All metal parts (except those carrying current or those in the snap-action structure) are stainless steel. The stainless steel case is covered with out-

side and inside with a special blue glass fused thermostatically high temperature. This special glass is chip-proof and has great dielectric strength with maximum recovery should a flash-over occur.

These new relays are standardized to be generally interchangeable with presently-used unsealed relays. The line is being extended continuously as to types and capacities. Be sure you have latest data and are listed to receive all new information as released. Write or wire today.

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Cutler-Hammer Leadership in Aircraft Control

Cutler-Hammer has long held the respect of the aircraft industry because this company has been part of the aircraft industry for 50 years. It has never been an accidental neighbor. It has pioneered the demands others have followed. It has sought to serve, continuously. It has been at the forefront of all progressive activity in standardization and long-range planning. It has supplied complete lines of equipment, not merely the items of today, but most profitable manufacture. Today, as for the decades past, Cutler-Hammer engineers are working closely with the aircraft industry's leaders — changing plans, planning, designing and building for the future. Here is the record:

1920 Cutler-Hammer designed and manufactured the first line of switches now created specifically for use in aircraft.

1925 Cutler-Hammer designed and manufactured the first die power relays now created specifically for use in aircraft.

1943 Cutler-Hammer designed and manufactured the first die power relays ever created specifically for use in aircraft.

1949 Cutler-Hammer started development of the first environment-free power relays for use in aircraft.

1950 Cutler-Hammer exhibited samples and notified test reports on the first hermetically sealed, fused glass in WADC and the Air Corps-Hammer recognition was adopted as industry standard by AEC.

1955 Cutler-Hammer designed and manufactured the first one-half mounting lever lock aircraft switches.



FILTER CENTER

►German Research Radar Field-Three modern radar systems, for use in air war, coastal or forward, Track-Set and Flare-Set are under construction by German AEG subsidiary of Telefunken. Radar which will have a range of about 140 miles, are the first of their type to be developed in Germany, since previous indications as such activity were blind. Completion is slated for early 1955.

►Capitex Corp.—Macmillan, Electronics division of General Instrument Corp. has received Signal Corps contract to develop techniques and facilities for mass production of test types of semiconductor bracketing capacitors.

►Spence Cauton Clocker—Automatic circuit checker which can test 8,750 different aircraft electrical circuits for faults, opens and reversed wiring is now three a month has been developed by Republic Aviation Corp. Tester automatically runs through sequence of current checks, stops when it finds a fault, circuit and identifies circuit by an indicating light. Replicable plans in manufacture and market the device in big models with capacities for 100, 250, 400, 550 and 1,700 circuits.

►Transperal Fluorophor on View—General Electric's new Transperal plus



Noise Chamber

High intensity noise noise pressure testing of electronic equipment under noise levels up to 145 db, which simulates those encountered in jets and missiles in flight. Developed by Radio Corporation of America, the noise room is available as two sizes: 9' x 9' x 24' or 18' x 30' x 27'. Noise chamber can generate white noise over operating frequency range of 20 to 10,000 cps.

AVIATION WEEK, July 12, 1957

What's going on up there?

American Electronic's new 380 KC Band Width RECORDER magnetic recording system gives an accurate, permanent record.

Specifically designed for recording data from satellites, missiles or other projects where extreme accuracy is required, RECORDER offers a new concept in recording and versatility. The magnetic channel system with its modular construction offers many unique features. For example, the standard tape speeds of 15, 30, 75, 150, 300 and 600 inches per second can be instantly selected with a push switch without changing belts or pulleys. Special speeds for still more push record are also available. Auto start controls assure constant tape tension from beginning to the end of the reel, regardless of size.

Quickly interchangeable tape reels accommodate 1/4", 1/2" or 1" tapes. The plot is an analog read assistant, an extremely accurate and precise data reader with its dual electronic waveform. Where taking and reliability are necessary in a data recording system you can depend on RECORDER, manufactured by American Electronics whose executives have been famous as quality builders. Write to Dept. 3316 for complete brochure and information.



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USPFD 0474 on how to select and apply flexible shafts. Write for Bulletin 3552.



Magnetic Timesaver

Small magnet attached to finger ring speeds assembly of various tubes at General Electric's Overhead, Ky., plant. Ring holds two poles, saving operator time reaching into box for each part. GE estimates magnetic ring speeds up assembly by 12%.

plans, which are applied to meter clear thickness to outline any tube across permitting spot and line rework. Loss approaching the diameter of the electron beam raised the two or three fold enlargement obtained in powdered phosphor screens, and is displayed at the Western Electronics Convention (Wisconsin, Aug. 12-15) in San Francisco. GE also will display its 5 bond voltage variable capacitors, type GL 6817, rated 0.5 watt for continuous wave operation.

► **U.S. Assistance-Packard Bell.** Electronic Corp. will supply technical assistance in the Toxicon Corporation Equipment Co., Ltd., of Kentucky, Inc., which will manufacture airborne ICF identification, (read or fix) equipment currently being produced by Packard Bell for the Air Force.

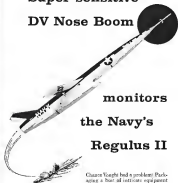
► **Long ADF's To Germany-German Air Ministry.** has placed \$200,000 order for airborne direction finding with Len Electronics GmbH, Munich, subsidiary of Lenz, Inc. German Air Force has ordered Long Model ADF-14D and seven long-range ADF-100.

► **Calling All Authors—Third annual Symposium on Acoustical Communication**, to be held in Ulster, N. Y., Nov. 6-8, is seeking authors to give technical papers. Classified papers (Confidential) will be presented at closed sessions on Nov. 6. Interested persons should send unclassified 250-word abstract, indicating whether paper itself will be classified, to Robert A. Zachan, General Electric, 601 West 8th St., Ulster, N. Y., before Aug. 1.

► **New Airac Microwave-Metrolite** microwave system has been purchased by Acoustical Radio Inc. for remote control of 26 high frequency transmitters located every mile from the Seattle Tacoma, Wash., airport.

Another DALMO VICTOR achievement

Super-sensitive DV Nose Boom



monitors
the Navy's
Regulus II

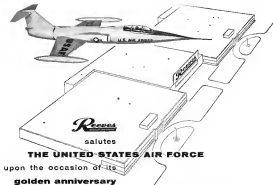
Charles Young had a problem! Packaging a boat of electronic equipment in a nose-boom boom to monitor the Navy's new guided missile, Regulus II. That "packaging" was ultimately solved by the Regulus II boom, the boom was folded passively by remote control.

Dalmo Victor's engineering skill, acquired through development of airborne radar sensor design, provided the answer!

The ten-foot DV pilot static boom, as required by the Navy, meets these most exacting design requirements and provides vital data, including direction and altitude, as well as angles of attack and yaw.

Long-recognized leader in airborne radar systems, Dalmo Victor now applies its experience and skills to create missile requirements. Contact the nearest DV office for help in solving similar problems.





Engineering and production of precision electronic equipment and systems for the UNITED STATES AIR FORCE is the daily, day-out concern of many hundreds of people and many specialized departments in the Revere organization. We take personal pride, therefore, in celebrating this great Service upon the occasion of its Golden Anniversary.

Among the many significant projects currently being advanced at Revere for the United States Air Force are the following:

- REAP® Electronic Analog Computers for the largest and most advanced installation of its kind at Wright Air Development Center.
- REAP® Electronic Analog Computer installations at White Sands Proving Grounds, Rome Air Development Center, Edwards, Eglin and Holbrook Air Force Bases.
- Revere ASG Close Support Control Mobile Radar Systems.
- Revere Range Instrumentation Radar installations at Patrick AFB.
- Revere Military Radar equipment in a wide range of special types for USAF installations throughout the world.
- Revere (general) computer systems for guidance control and many other applications.

In addition to participation in these USAF projects and manufacture of a wide range of precision electronic components for USAF supplies, Revere's research and engineering plays a continuing role in the advancement of vital projects for the other Services.

REEVES INSTRUMENT CORPORATION
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Talos Blends Guidance Systems

Researcher in mixed phase of its attack, Navy's Talos missile blends its guidance from its predecessor, Tartar, in using a sensitive heading system to find phase, possibly ground radar signals reflected off target. Firing was at White Sands Proving Ground, N. M.

Rafax Adds Link for Control Area Radar

New York—Control of the New York Air Route Traffic Control Center is enhancing a remote radar display system, called Rafax, that has made possible the integrated presentation of three long-range AN/TWS-1 radar displays with that of the two conventional radars at New York and Long Beach.

With improved air traffic control and increased safety for the jet-transport commercial jet age at the post, the Civil Aeronautics Administration will be conducting extensive tests all the while over the next two months for its Tech-Link Development and Evaluation Center at Indianapolis.

Rafax provides for the transmission of video signals over standard one channel telephone lines. Although some sound transmission systems such as microwave links or coaxial cables are simpler and provide better definition,

they are considerably more costly. A microwave microwave link of suitable quality would run for about \$1,000 per mile each month as opposed to a \$10 per mile/month rental for a Class A telephone line used with Rafax.

The Rafax system is a development of Hutter, Raymond and Brown, Inc. of State College, Pa., a division of Teeg Industries, Inc. According to Robert F. Cline, Teeg vice president, a number of Rafax systems are in service, and

Rafax, according to its developers, will extend the radar coverage possible for the traffic controllers by, permitting the presentation of displays from radar located remotely throughout their control area. This would assure more positive control of air traffic and permit more rapid separation of crossing air craft, thus reducing the controller's dependence on pilot's position reports.

The Rafax system will, in addition, reduce the chatter present on radar radar scopes and eliminate the "over load" load up of the local radar.



Check the program line and contact with your name and address if you want more information on the complete line of aircraft instruments offered to military, commercial, and business aviation by General Electric's Instrument Department at West Lynn, Maine. Revere to Boston 280-22, General Electric Company, September 5, 1967.

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Performance features of TORRINGTON CAM FOLLOWERS



Heavy hardened roller
runs to 4000 ft. high rolling
and shock loads.



Tapered roller for dis-
tributed loading, even
hardness with tough
case for high strength in
withstand shock loads.



Roller hardened to
prevent wear and
distortion under
heavy loads.



Full length hardened
case resists wear
and distortion under
heavy loads.



Roller hardened to
prevent wear and
distortion under
heavy loads.

Built to "FOLLOW THROUGH" under high shock loads

Every feature of the Torrington Cam Follower is designed to insure efficient performance and long service life under heavy rolling and shock loads in cam or track follower service.

Precision made throughout, Torrington Cam Followers are available in sizes from 1/8" to 2 1/4" O.D. Special surface finishes such as chrome and chromium plate or oxide black can be provided.

Our engineering staff will be glad to work with you in applying these reliable units to your cam-controlled or track-type equipment. You can depend on Torrington Cam Followers to "follow through" on the job because every element is designed for maximum capacity. The Torrington Company, Torrington, Conn.—3rd South Road 21, Ind.

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • BALL • NEEDLE ROLLERS • THROAT

1958 U. S. Airport Aid Available

Federal money became available this month for 514 airport improvement projects in the Fiscal 1958 Federal Aid Airport Program, the third of four such programs authorized by Congress.

Funds for the construction United States including over state but Wisconsin and Wisconsin amount to \$52,285,216. An additional \$5,770,000 is provided for the Territories. Matching local funds are available or will be provided.

The projects in the Fiscal 1958 program by state and territory:

NEW JERSEY AIRPORT TOTALS (all projects approved for)

ALABAMA 1 \$149,000

City of Birmingham
Modernized Airport.
Will be completed and will be for building concrete structures, parking facilities, land acquisition, water service.

Arkansas 1 \$1,000

City of Dallas
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

California 1 \$1,000

City of Los Angeles
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Colorado 1 \$1,000

City of Denver
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Connecticut 1 \$1,000

City of Hartford
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Delaware 1 \$1,000

City of Dover
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

District of Columbia 1 \$1,000

City of Washington
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Florida 1 \$1,000

City of Miami
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Georgia 1 \$1,000

City of Atlanta
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Hawaii 1 \$1,000

City of Honolulu
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Idaho 1 \$1,000

City of Boise
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Illinois 1 \$1,000

City of Chicago
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Indiana 1 \$1,000

City of Indianapolis
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Iowa 1 \$1,000

City of Des Moines
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Kansas 1 \$1,000

City of Topeka
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Kentucky 1 \$1,000

City of Louisville
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Louisiana 1 \$1,000

City of New Orleans
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Maine 1 \$1,000

City of Portland
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Maryland 1 \$1,000

City of Baltimore
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Massachusetts 1 \$1,000

City of Boston
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Michigan 1 \$1,000

City of Detroit
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Minnesota 1 \$1,000

City of Minneapolis
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Mississippi 1 \$1,000

City of Jackson
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Further, related facilities and some facilities also obtained through state and federal money made to facilities also completed water parking area.

Montgomery 1 \$1,000

City of Montgomery
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Nebraska 1 \$1,000

City of Omaha
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Nevada 1 \$1,000

City of Las Vegas
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

New Hampshire 1 \$1,000

City of Portsmouth
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

New Jersey 1 \$1,000

City of Newark
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

New Mexico 1 \$1,000

City of Albuquerque
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

New York 1 \$1,000

City of New York
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

North Carolina 1 \$1,000

City of Raleigh
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

North Dakota 1 \$1,000

City of Bismarck
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Ohio 1 \$1,000

City of Columbus
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Oklahoma 1 \$1,000

City of Oklahoma City
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Oregon 1 \$1,000

City of Portland
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.

Pennsylvania 1 \$1,000

City of Philadelphia
Modernized Airport.
Land acquisition—water service and sewer extension, material and light parking facilities, etc.



Low-Cost Hangar at Baltimore

Steel hangar recently delivered at Friendship International Airport, Baltimore, cost less than \$10 per sq. ft. in total. Used hangar cost a total of \$14 sq. ft. The low-cost structure built by Lane Engineering Co., measures 200 x 100 ft., is suited for 90 mph winds.

[illegible]

Write for complete information:

2639 N. Miami Street • Burbank, Calif. • March 9, 1987

The unit illustrated above has a 1/2" stroke with 16 watt electrical servo input. It is in production. The design may be modified to any desired stroke, with inputs of 60 watts and lower. Hydraulic Research's new servo system design utilizes a basic dry rod torque motor servo valve. It is compact, lightweight, and adaptable to any application where precise positioning is required.



2014 RELEASE

FLORIDA

[illegible]

Foot Photo: The foot of a person with a
fracture of the 5th metatarsal.
St. Louis County Hospital
Small tubular internally
fixed (Kirsch) internal system

Miami	1,150,000
Daily Census Airport	
Northrop	
Wright Patterson Air Force Base	
Commercial terminal airport	



Our wealth of experience has been in manufacture of precision parts for AIRCRAFT, GUIDED MISSILES, ELECTRONICS & ORDNANCE. We are handling the toughest of production problems for leaders in these industries. Let us apply our specialized knowledge and skill to solve your manufacturing problems.



8548 PULASKI HIGHWAY, BALTIMORE 21, MARYLAND
TELEPHONE: MURDOCK 4-2000



$$E=mc^2$$

Atomic power in Caesar's day?

Certainly!

It was there, in the ground, in the air and water. It always had been. There are no more "new materials" today than there were when Rome ruled the world.

The only thing new is knowledge—knowledge of how to get it and rearrange raw materials. Every invention of modern times was “available” to Ramses, Caesar, Charlemagne.

In that sense, then, we have available today an existing raw materials the inventions that can make our lives longer, happier, and more comfortably easier. We need only knowledge to bring them into reality.

Could there possibly be a better argument for the strengthening of our sources of knowledge—our colleges and universities? Can we possibly deny that the welfare, progress—indeed the very fate—of our nation depends on the quality of knowledge generated and transmitted by these institutions of higher learning?

It is almost unbelievable that a society such as ours, which has profited so vastly from an accelerated accumulation of knowledge, should allow anything to threaten the well-being of our language.

Yet this is the case

The crisis that confronts our colleges today threatens to weaken seriously their ability to produce the kind of graduates who can assimilate and carry forward our rich heritage of learning.

The crisis is composed of several elements: a salary scale that is driving away from teaching the kind of mind most qualified to teach, overcrowded classrooms; and a mounting pressure for enrollment that will double by 1987.

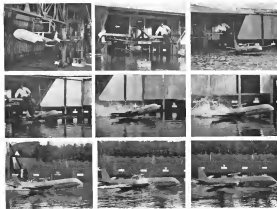
In a very real sense our personal and national progress depends on our colleges. They must have our aid.

Help the college or university of your choice. Help them plan for stronger facilities and expansion. The returns will be greater than you think.

If you want to know what the college scene means to you, write for a free book, let us: **HIGHER EDUCATION**, Box 36, Times Square Station, New York 36, New York.



Sponsored as a public service, in cooperation with the Council for Financial Aid to Education



Ditching Vanguard Model

State	Project Name	Location	Size (Acres)	Value (\$)	Notes
Alabama	Alabama State Capitol	Montgomery	100	100,000	State Capitol building
Alaska	Alaska State Capitol	Juneau	100	100,000	State Capitol building
Arizona	Arizona State Capitol	Tucson	100	100,000	State Capitol building
Arkansas	Arkansas State Capitol	Fayetteville	100	100,000	State Capitol building
California	California State Capitol	Sacramento	100	100,000	State Capitol building
Colorado	Colorado State Capitol	Denver	100	100,000	State Capitol building
Connecticut	Connecticut State Capitol	Hartford	100	100,000	State Capitol building
Delaware	Delaware State Capitol	Dover	100	100,000	State Capitol building
Florida	Florida State Capitol	Tallahassee	100	100,000	State Capitol building
Georgia	Georgia State Capitol	Atlanta	100	100,000	State Capitol building
Hawaii	Hawaii State Capitol	Honolulu	100	100,000	State Capitol building
Idaho	Idaho State Capitol	Boise	100	100,000	State Capitol building
Illinois	Illinois State Capitol	Springfield	100	100,000	State Capitol building
Indiana	Indiana State Capitol	Indianapolis	100	100,000	State Capitol building
Iowa	Iowa State Capitol	Des Moines	100	100,000	State Capitol building
Kansas	Kansas State Capitol	Topeka	100	100,000	State Capitol building
Kentucky	Kentucky State Capitol	Frankfort	100	100,000	State Capitol building
Louisiana	Louisiana State Capitol	Baton Rouge	100	100,000	State Capitol building
Maine	Maine State Capitol	Oakland	100	100,000	State Capitol building
Maryland	Maryland State Capitol	Annapolis	100	100,000	State Capitol building
Massachusetts	Massachusetts State Capitol	Springfield	100	100,000	State Capitol building
Michigan	Michigan State Capitol	Lansing	100	100,000	State Capitol building
Minnesota	Minnesota State Capitol	St. Paul	100	100,000	State Capitol building
Mississippi	Mississippi State Capitol	Jackson	100	100,000	State Capitol building
Missouri	Missouri State Capitol	Jefferson City	100	100,000	State Capitol building
Montana	Montana State Capitol	Helena	100	100,000	State Capitol building
Nebraska	Nebraska State Capitol	Lincoln	100	100,000	State Capitol building
Nevada	Nevada State Capitol	Carson City	100	100,000	State Capitol building
New Hampshire	New Hampshire State Capitol	Concord	100	100,000	State Capitol building
New Jersey	New Jersey State Capitol	Trenton	100	100,000	State Capitol building
New Mexico	New Mexico State Capitol	Santa Fe	100	100,000	State Capitol building
New York	New York State Capitol	Albany	100	100,000	State Capitol building
North Carolina	North Carolina State Capitol	Raleigh	100	100,000	State Capitol building
North Dakota	North Dakota State Capitol	Bismarck	100	100,000	State Capitol building
Ohio	Ohio State Capitol	Columbus	100	100,000	State Capitol building
Oklahoma	Oklahoma State Capitol	Oklahoma City	100	100,000	State Capitol building
Oregon	Oregon State Capitol	Salem	100	100,000	State Capitol building
Pennsylvania	Pennsylvania State Capitol	Harrisburg	100	100,000	State Capitol building
Rhode Island	Rhode Island State Capitol	Providence	100	100,000	State Capitol building
South Carolina	South Carolina State Capitol	Columbia	100	100,000	State Capitol building
South Dakota	South Dakota State Capitol	Sioux Falls	100	100,000	State Capitol building
Tennessee	Tennessee State Capitol	Nashville	100	100,000	State Capitol building
Texas	Texas State Capitol	Austin	100	100,000	State Capitol building
Vermont	Vermont State Capitol	Montpelier	100	100,000	State Capitol building
Virginia	Virginia State Capitol	Richmond	100	100,000	State Capitol building
Washington	Washington State Capitol	Olympia	100	100,000	State Capitol building
West Virginia	West Virginia State Capitol	Charleston	100	100,000	State Capitol building
Wisconsin	Wisconsin State Capitol	Madison	100	100,000	State Capitol building
Wyoming	Wyoming State Capitol	Cheyenne	100	100,000	State Capitol building



High pressure centrifugal air compressors for engine test. The two units in foreground operate on purified and tank air to high pressure tank in background.

ALLIS-CHALMERS COMPRESSORS

for every
aviation test need

ALLIS-CHALMERS has installed compressor equipment totaling nearly 600,000 hp... 6,000,000 cfm in aviation test facilities including wind tunnels, and engine and component testing. This is your assurance of highly experienced assistance during design, installation and operating stages. Whatever your problem, call the A-C office in your area or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wis.



Engine test exhausters. One of several tandem-driven centrifugal gas exhauster sets in an engine exhaust pipe plant.



Rem air compressors. Two unit compressions down to single meter are installed in a refrigeration research plant. Allis-Chalmers builds all sizes of steel compressors for small or large wind tunnel air circulation and other applications.

Altitude simulation and component testing with vacuum pumps. This line of single-stage rotary units is installed in an altitude test laboratory in the Midwest.

Wichita City
City of Wichita
Wichita Airport
Land, construction—deep water
pumping, construction and dredging
pumping, construction and dredging
pumping, construction and dredging

\$170,000

Wichita City
City of Wichita
Wichita Airport
Land, construction—airport, development, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

TOTAL

\$100,000

Wichita City

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

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construction—airport, etc. construction

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construction—airport, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
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Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
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Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

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Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

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Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

Wichita City
City of Wichita
Wichita Airport
Aircraft site and clear areas
construction—airport, etc. construction

\$10,000

AVIATION WEEK, July 13, 1957



developed for extreme temperature
ranges in supersonic jets...

Stratoflex "Super-T" hose assemblies are designed for extremely high and low temperatures. Stratoflex "Super-T" tube is extruded from specially compounded Teflon® and reinforced with high strength, corrosion resistant stainless steel wire braid. "Super-T" is unaffected by fuels, petroleum or synthetic base lubricants, acids, solvents, alcohols, and coolants. It is non-inflammable and the shell and operating life are positively unlimited to provide long and trouble free service.

Stratoflex is a registered
trademark



Straight 45° and 90° fittings in stock



Stratoflex "Super-T" hose is available in standard sizes from 1/4" to 36". It is a heavy extruded, flexible, permanently attached, corrosion resistant, high temperature or high-pressure hose. Special modifications available to your specifications. Write for information 25-2 Bulletin.



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New York
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Seattle, Portland
Tulsa

ALLIS-CHALMERS



Transistorized Operations

• Model MIL-E-3212 • -65°C to +125°C temperature range

	200 g	500 g	1000 g	2000 g	5000 g
Rated Torque	1.500 in-oz	3.750 in-oz	7.500 in-oz	15.000 in-oz	37.500 in-oz
Maximum Load	900	2250	4500	9000	22500
Speed at 20000 rpm	10	25	50	100	250
As Load Increases	4000	10000	20000	40000	100000
Speed at 10000 rpm	20	50	100	200	500
Speed at 5000 rpm	40	100	200	400	1000
Speed at 2500 rpm	80	200	400	800	2000
Speed at 1250 rpm	160	400	800	1600	4000
Speed at 625 rpm	320	800	1600	3200	8000
Speed at 312 rpm	640	1600	3200	6400	16000
Speed at 156 rpm	1280	3200	6400	12800	32000
Speed at 78 rpm	2560	6400	12800	25600	64000
Speed at 39 rpm	5120	12800	25600	51200	128000
Speed at 19 rpm	10240	25600	51200	102400	256000
Speed at 9 rpm	20480	51200	102400	204800	512000
Speed at 4 rpm	40960	102400	204800	409600	1024000
Speed at 2 rpm	81920	204800	409600	819200	2048000
Speed at 1 rpm	163840	409600	819200	1638400	4096000
Speed at 0.5 rpm	327680	819200	1638400	3276800	8192000
Speed at 0.25 rpm	655360	1638400	3276800	6553600	16384000
Speed at 0.125 rpm	1310720	3276800	6553600	13107200	32768000
Speed at 0.0625 rpm	2621440	6553600	13107200	26214400	65536000
Speed at 0.03125 rpm	5242880	13107200	26214400	52428800	131072000
Speed at 0.015625 rpm	10485760	26214400	52428800	104857600	262144000
Speed at 0.0078125 rpm	20971520	52428800	104857600	209715200	524288000
Speed at 0.00390625 rpm	41943040	104857600	209715200	419430400	1048576000
Speed at 0.001953125 rpm	83886080	209715200	419430400	838860800	2097152000
Speed at 0.0009765625 rpm	167772160	419430400	838860800	1677721600	4194304000
Speed at 0.00048828125 rpm	335544320	838860800	1677721600	3355443200	8388608000
Speed at 0.000244140625 rpm	671088640	1677721600	3355443200	6710886400	16777216000
Speed at 0.0001220703125 rpm	1342177280	3355443200	6710886400	13421772800	33554432000
Speed at 0.00006103515625 rpm	2684354560	6710886400	13421772800	26843545600	67108864000
Speed at 0.000030517578125 rpm	5368709120	13421772800	26843545600	53687091200	134217728000
Speed at 0.0000152587890625 rpm	10737418240	26843545600	53687091200	107374182400	268435456000
Speed at 0.00000762939453125 rpm	21474836480	53687091200	107374182400	214748364800	536870912000
Speed at 0.000003814697265625 rpm	42949672960	107374182400	214748364800	429496729600	1073741824000
Speed at 0.0000019073486328125 rpm	85899345920	214748364800	429496729600	858993459200	2147483648000
Speed at 0.00000095367431640625 rpm	171798691840	429496729600	858993459200	1717986918400	4294967296000
Speed at 0.000000476837158203125 rpm	343597383680	858993459200	1717986918400	3435973836800	8589934592000
Speed at 0.0000002384185791015625 rpm	687194767360	1717986918400	3435973836800	6871947673600	17179869184000
Speed at 0.00000011920928955078125 rpm	1374389534720	3435973836800	6871947673600	13743895347200	34359738368000
Speed at 0.000000059604644775390625 rpm	2748779069440	6871947673600	13743895347200	27487790694400	68719476736000
Speed at 0.0000000298023223876953125 rpm	5497558138880	13743895347200	27487790694400	54975581388800	137438953472000
Speed at 0.00000001490116119384765625 rpm	10995116277760	27487790694400	54975581388800	109951162777600	274877906944000
Speed at 0.000000007450580596923828125 rpm	21990232555520	54975581388800	109951162777600	219902325555200	549755813888000
Speed at 0.0000000037252902984619140625 rpm	43980465111040	109951162777600	219902325555200	439804651110400	1099511627776000
Speed at 0.00000000186264514923095703125 rpm	87960930222080	219902325555200	439804651110400	879609302220800	2199023255552000
Speed at 0.000000000931322574615478515625 rpm	175921860444160	439804651110400	879609302220800	1759218604441600	4398046511104000
Speed at 0.0000000004656612873077392578125 rpm	351843720888320	879609302220800	1759218604441600	3518437208883200	8796093022208000
Speed at 0.00000000023283064365386962890625 rpm	703687441776640	1759218604441600	3518437208883200	7036874417766400	17592186044416000
Speed at 0.000000000116415321826934814453125 rpm	1407374883553280	3518437208883200	7036874417766400	14073748835532800	35184372088832000
Speed at 0.0000000000582076609134674072265625 rpm	2814749767106560	7036874417766400	14073748835532800	28147497671065600	70368744177664000
Speed at 0.00000000002910383045673370361328125 rpm	5629499534213120	14073748835532800	28147497671065600	56294995342131200	140737488355328000
Speed at 0.000000000014551915228366851806640625 rpm	11258999068426240	28147497671065600	56294995342131200	112589990684262400	281474976710656000
Speed at 0.0000000000072759576141834259033203125 rpm	22517998136852480	56294995342131200	112589990684262400	225179981368524800	562949953421312000
Speed at 0.00000000000363797880709171295166015625 rpm	45035996273704960	112589990684262400	225179981368524800	450359962737049600	1125899906842624000
Speed at 0.000000000001818989403545856475830078125 rpm	90071992547409920	225179981368524800	450359962737049600	900719925474099200	2251799813685248000
Speed at 0.0000000000009094947017729282379150390625 rpm	180143985094819840	450359962737049600	900719925474099200	1801439850948198400	4503599627370496000
Speed at 0.00000000000045474735088646191895751953125 rpm	360287970189639680	900719925474099200	1801439850948198400	3602879701896396800	9007199254740992000
Speed at 0.000000000000227373675443230959478759765625 rpm	720575940379279360	1801439850948198400	3602879701896396800	7205759403792793600	18014398509481984000
Speed at 0.000000000000113686837721615479739379878125 rpm	1441151880758558720	3602879701896396800	7205759403792793600	14411518807585587200	36028797018963968000
Speed at 0.0000000000000568434188608077398696899378125 rpm	2882303761517117440	7205759403792793600	14411518807585587200	28823037615171174400	72057594037927936000
Speed at 0.000000000000028421709430403869934844968953125 rpm	5764607523034234880	14411518807585587200	28823037615171174400	57646075230342348800	144115188075855872000
Speed at 0.00000000000001421085471520193049722224968953125 rpm	11529215046068469760	28823037615171174400	57646075230342348800	115292150460684697600	288230376151711744000
Speed at 0.000000000000007105427357600965248611124968953125 rpm	23058430092136939520	57646075230342348800	115292150460684697600	230584300921369395200	576460752303423488000
Speed at 0.0000000000000035527136788004826243055624968953125 rpm	46116860184273879040	115292150460684697600	230584300921369395200	461168601842738790400	1152921504606846976000
Speed at 0.00000000000000177635683940024131215278124968953125 rpm	92233720368547758080	230584300921369395200	461168601842738790400	922337203685477580800	2305843009213693952000
Speed at 0.000000000000000888178419700120656076390624968953125 rpm	184467440737095516160	461168601842738790400	922337203685477580800	1844674407370955161600	4611686018427387904000
Speed at 0.0000000000000004440892098500603280381953124968953125 rpm	368934881474191032320	922337203685477580800	1844674407370955161600	3689348814741910323200	9223372036854775808000
Speed at 0.00000000000000022204460492503016401909765624968953125 rpm	737869762948382064640	1844674407370955161600	3689348814741910323200	7378697629483820646400	18446744073709551616000
Speed at 0.00000000000000011102230246251507800954878124968953125 rpm	1475739525896764129280	3689348814741910323200	7378697629483820646400	14757395258967641292800	36893488147419103232000
Speed at 0.000000000000000055511151231257539004774378124968953125 rpm	2951479051793528258560	7378697629483820646400	14757395258967641292800	29514790517935282585600	73786976294838206464000
Speed at 0.00000000000000002775557561562876950238718953124968953125 rpm	5902958103587056517120	14757395258967641292800	29514790517935282585600	59029581035870565171200	147573952589676412928000
Speed at 0.000000000000000013877787807814384751193718953124968953125 rpm	11805916207174113034240	29514790517935282585600	59029581035870565171200	118059162071741130342400	295147905179352825856000
Speed at 0.0000000000000000069388939039071923755968953124968953125 rpm	23611832414348226068480	59029581035870565171200	118059162071741130342400	236118324143482260684800	590295810358705651712000
Speed at 0.00000000000000000346944695195359618779844968953124968953125 rpm	47223664828696452136960	118059162071741130342400	236118324143482260684800	472236648286964521369600	1180591620717411303424000
Speed at 0.000000000000000001734723475976798093899224968953124968953125 rpm	94447329657392904273920	236118324143482260684800	472236648286964521369600	944473296573929042739200	2361183241434822606848000
Speed at 0.0000000000000000008673617379883990469496124968953124968953125 rpm	188894659314785808547840	472236648286964521369600	944473296573929042739200	1888946593147858085478400	4722366482869645213696000
Speed at 0.00000000000000000043368086899419952347480624968953124968953125 rpm	377789318629571617095680	944473296573929042739200	1888946593147858085478400	3777893186295716170956800	9444732965739290427392000
Speed at 0.000000000000000000216840434497099761737403124968953124968953125 rpm	755578637259143234191360	1888946593147858085478400	3777893186295716170956800	7555786372591432341913600	18889465931478580854784000
Speed at 0.0000000000000000001084202172485498808687015624968953124968953125 rpm	1511157274518286468382720	3777893186295716170956800	7555786372591432341913600	15111572745182864683827200	37778931862957161709568000
Speed at 0.00000000000000000005421010862427494043435078124968953124968953125 rpm	3022314549036572936765440	7555786372591432341913600	15111572745182864683827200	30223145490365729367654400	75557863725914323419136000
Speed at 0.000000000000000000027105054312137470217175390624968953124968953125 rpm	6044629098073145873530880	15111572745182864683827200	30223145490365729367654400	60446290980731458735308800	151115727451828646838272000
Speed at 0.0000000000000000000135525271560687351085876953124968953124968953125 rpm	12089258196146291747061760	30223145490365729367654400	60446290980731458735308800	120892581961462917470617600	302231454903657293676544000
Speed at 0.0000000000000000000067762635780337175542938478124968953124968953125 rpm	24178516392292583494123520	60446290980731458735308800	120892581961462917470617600	241785163922925834941235200	



"An infinite capacity for taking pains"

The above familiar phrase is usually given as a definition of genius. We believe it is a job description.

The people to whom our Quality Control people give this phrase are the designers of our complex products, are truly painstaking, and are applied equally to components we make ourselves and those we purchase from outside suppliers.

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Experiments by ultrasonic, seeking welding faults, minute cracks in glass, and even subatomic loose particles inside the tube.

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Greenboro Airport	\$7,500
Greenboro	
General machine	
and machine—also seven	
W. H. W. C. building.	

GREENSBORO	
Greenboro County	\$1,000
Greenboro County Airport	
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own—several other buildings.	

SPRINGFIELD	
City of Springfield	\$5,000
Springfield Airport	
Land acquisition—also seven	
W. H. W. C. building.	

SPRINGFIELD	
City of Springfield	\$7,500
Springfield Airport	
General machine to build their	
own—several other buildings.	

SOUTH DAKOTA	
South Dakota	\$11,000
City of Rapid City	
General machine	
Land acquisition—also seven	
W. H. W. C. building.	

SOUTH DAKOTA	
City of Rapid City	\$7,500
General machine	
Land acquisition—also seven	
W. H. W. C. building.	

SENEGAL	
Senegal	\$11,000
City of Dakar	
General machine	
Land acquisition—also seven	
W. H. W. C. building.	

SENEGAL	
City of Dakar	\$7,500
General machine	
Land acquisition—also seven	
W. H. W. C. building.	

SENEGAL	
City of Dakar	\$11,000
General machine	
Land acquisition—also seven	
W. H. W. C. building.	

SENEGAL	
City of Dakar	\$7,500
General machine	
Land acquisition—also seven	
W. H. W. C. building.	

SENEGAL	
City of Dakar	\$11,000
General machine	
Land acquisition—also seven	
W. H. W. C. building.	

SENEGAL	
City of Dakar	\$7,500
General machine	
Land acquisition—also seven	
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Crusader's Refueling Probe

Here are three stages of operation of the refueling probe of Chance Vought Aircraft's F7U1 Crusader for fighter. Top picture shows refueling probe in disengagement position. With housing door open, center refueling probe is shown in extended position. When fully extended bottom, nose of probe is opposite pilot's head so he can work engagement with tanker's drogue.

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Classification	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Development	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
TOTAL	\$30,000

MISSILE TESTING	
Which	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Classification	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Development	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
TOTAL	\$30,000

MISSILE TESTING	
Which	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Classification	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Development	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
TOTAL	\$30,000

MISSILE TESTING	
Which	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Classification	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Development	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
TOTAL	\$30,000

MISSILE TESTING	
Which	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Classification	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Development	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
TOTAL	\$30,000

MISSILE TESTING	
Which	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Classification	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Development	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
TOTAL	\$30,000

MISSILE TESTING	
Which	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
Classification	\$10,000
Office of Research Thrusting Aircraft, Rocket Motor and Jet, MISSILE Development and Test	
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